Ohio Agricultural Experiment Station

BULLETIN 135

AND

TWENTY-FIRST ANNUAL REPORT

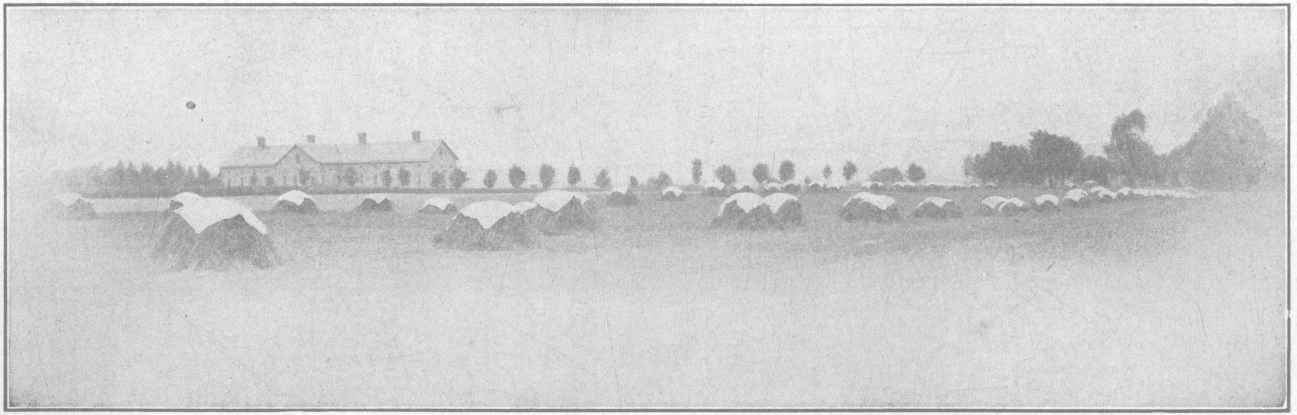
FOR

1901-1902.

WOOSTER, OHIO, JULY, 1902.

The Bulletins of this Station are sent free to all residents of the State who request them. Persons who desire their address changed should give both old and new address. All correspondence should be addressed to EXPERIMENT STATION, WOOSTER, OHIO.

WOOSTER, O.:
EXPERIMENT STATION PRESS
1902



In harvest time.

Twenty-First Annual Report

OF THE

Ohio Agricultural Experiment Station

For the Year Ending June 30, 1902.

Published by Order of the State Legislature.

WOOSTER, O.:
EXPERIMENT STATION PRESS
1902

ANNOUNCEMENT

The Ohio Agricultural Experiment Station is organized under an act of the General Assembly of Ohio, passed April 17, 1882, and supplemented by an act of Congress, approved March 2, 1887.

WHAT THE STATION CAN DO

The Station offers its advice and assistance to the farmers of Ohio along the following lines:

The maintenance of soil fertility, including the rotation of crops and the selection and use of manures and fertilizing materials.

The selection of varieties of grains, grasses and forage crops and methods of culture.

The selection of varieties of fruits and vegetables and the management of orchards.

The examination of seeds that are suspected of being unsound or adulterated; the identification of grasses, weeds and other plants; the prevention of fungous diseases of plants.

The identification of insects and the control of such as are injurious.

The feeding of animals, including calculation of rations and use of various feeding stuffs.

The planting and care of forest trees and the management of farm woodlots.

WHAT THE STATION CANNOT DO.

The Station is ***not*** prepared to analyze commercial fertilizers and feeding stuffs, as in Ohio that work is placed in charge of the SECRETARY OF THE STATE BOARD OF AGRICULTURE, at Columbus, to whom all requests for such analyses should be addressed.

The Station is ***not*** prepared to give advice respecting treatment of contagious diseases of animals, that function having been transferred to the State Board of Agriculture in its capacity of State Live Stock Commission. Requests for such advice should therefore be addressed to SECRETARY, STATE LIVE STOCK COMMISSION, Department of Agriculture, Columbus, Ohio.

The Station is ***not*** prepared to examine animals suspected of having been poisoned. Such examinations should be referred to the nearest Veterinarian.

The Station is ***not*** prepared to make official inspection of orchards and nurseries under the law requiring such inspection, that work having been transferred to the STATE BOARD OF AGRICULTURE to whose SECRETARY, Columbus, requests for such inspection should be addressed.

The Station is ***not*** prepared to examine foods, drugs and dairy products suspected of adulteration, as that work is in charge of the OHIO DAIRY AND FOOD COMMISSIONER whose office is at Columbus.

The Station is ***not*** prepared to analyze drinking water; requests for such analysis should be addressed to the SECRETARY OF THE STATE BOARD OF HEALTH, Columbus.

Visitors to the Station or to its various test farms are welcome at all times during business hours. Persons or parties who contemplate such visits and who desire special attention are requested to write in advance, giving date of proposed visit and probable number of party.

Any citizen of Ohio has the right to apply to the Station for such assistance as it can give, and all such requests will receive prompt attention.

The Bulletins of this Station are sent free to all residents of the State who request them.

Address all communications to

EXPERIMENT STATION,

Wooster, Ohio.

ORGANIZATION OF THE

OHIO AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL.

ALVA AGEE, President.....Cheshire
O. E. BRADFUTE, Secretary.....Xenia
D. L. SAMPSON, Treasurer.....Cincinnati
HON. FRIEND WHITTLESEY.....Atwater
D. D. WHITE.....Castalia

STATION STAFF.

CHARLES E. THORNE, M. A. S.....Director

WILLIAM J. GREEN.....Horticulturist and Vice Director
(Superintendent of Orchards, Gardens and Greenhouses.)

AUGUSTINE D. SELBY, B. Sc.....Botanist
(In charge of botanical and plant physiological and pathological investigations.)

C. G. WILLIAMS.....Agriculturist
(Superintendent of Farm.)

JOHN W. AMES, B. Sc.....Chemist
P. J. PARROTT, A. M.....Entomologist
WILLIAM H. KRAMER.....Bursar
CLARENCE W. WAID, B. Sc.....Assistant Horticulturist
J. S. HOUSER.....Assistant Entomologist
G. M. LUMMIS, B. S. A.....Assistant Botanist
WILLIAM HOLMES.....Farm Foreman
CHARLES A. PATTON.....Meteorological Observer
CARY WELTY.....Mechanic
JAMES L. TAGGART.....Horticultural Foreman
FAYE BLAYNEY.....Mailing Clerk
MARY M. LEE.....Stenographer
FRANK W. GLASS.....Printer

EDWARD MOHN.....Supt. Northeastern Test-farm, Strongsville
HENRY M. WACHTER.....Supt. Southwestern Test-farm, Germantown
LEWIS SCHULTZ.....Supt. Southeastern Test-farm, Carpenter

The Bulletins of this Station are issued at irregular intervals. They are paged consecutively, and an index is included with the Annual Report, which constitutes the final number of each yearly volume.

REPORT OF THE BOARD OF CONTROL.

To His Excellency, GEORGE K. NASH, *Governor of Ohio.*

SIR:—The twenty-first annual report of the Ohio Agricultural Experiment Station, for the year ended June 30th, 1902, is herewith respectfully submitted.

In your last annual message to the General Assembly occurs the following paragraph:

"The law as it now exists authorizes the governor to appoint the members of the board of control of the agricultural experiment station, located at Wooster, O., and provides that the governor shall be a member ex-officio. It is a mistake to require the governor to serve upon a board with members appointed by him. Again, his duties as governor are so numerous that he does not have an opportunity to give to this office such personal attention as it should receive from a member of the board of control. The director of the station, appointed by the board of control, is also made an ex-officio member. It is a mistaken policy to make him a member of the board which has the appointing power. The law should be so changed as to permit the governor to appoint five members of the board of control, and then give the board the power to elect the director of the station."

Pursuant to this suggestion a bill was introduced by Hon. U. F. Wells, Representative from Wayne county, which became a law in the following form:

Be it enacted by the General Assembly of the State of Ohio;

SECTION 1. That sections 409-2, 409-3, 409-4, 409-5, and 409-6 of the Revised Statutes of Ohio be so amended as to read as follows:

Sec. 409-2. The government of said experiment station shall be vested in a board of control, consisting of five members, not more than three of whom shall belong to the same political party, who shall be appointed by the governor, by and with the advice and consent of the senate, and whose term of office shall be for five years, except that those first appointed under this act shall hold office for one, two, three, four and five years respectively, the terms to be fixed by the governor in their commissions. In case a vacancy shall occur in the board an appointment shall be made by the governor for the unexpired term. The members of the board shall be paid their necessary expenses while engaged in the discharge of their official duties, but they shall not receive compensation for their services.

Sec. 409-3. On the passage of this act the governor shall appoint the board of control and shall at once call them together, when they shall organize by the election of a president, secretary and treasurer. The board shall hold an annual meeting in Columbus during the week beginning with the first Monday in March, and special meetings at other times and places upon a call of the president, or

upon a written request of two members of the board. Three members shall constitute a quorum for the transaction of business.

Sec. 409-4. The board of control of said experiment station is hereby constituted a body corporate, with the power of suing and being sued, of contracting and being contracted with, and of making and using a common seal and altering the same at pleasure; they shall have the power to receive and hold in trust, for the use and benefit of said station, any grant or devise of land, and any donation or bequest of money or personal property, to be applied to the general or special use of the station, as may be directed by the donor; the board shall appoint a director at their meeting on the first Monday in March, 1902, who shall be a person of acknowledged ability and training in the principles and practice of scientific agriculture; they shall adopt by-laws, rules and regulations for the government of the station; they shall make an annual report of their experiments and work to the governor of the state and the same shall be published annually in the Ohio agricultural report and five thousand copies separate in pamphlet form for free distribution, and the pamphlet copies to be printed and paid for, the same as other public printing; they shall fix the salaries and terms of office of all officers and employes of the station; and they shall have power to remove at any time for cause, sustained by written charges, any officer or employe of the station.

SEC. 409-5. The director shall have control of the affairs of the station in all its departments, and shall be responsible to the board of control for the efficient management thereof; with the approval of the board of control he shall appoint such chiefs of department, assistants and other employes as may be necessary for the proper management of the station, and shall assign them to their respective duties. The director shall have authority to suspend any officer or employe of the station for cause, he at once to report the same, with reasons therefor, to the board of control for final action.

SEC. 409-6. The title of all lands for the use of said experiment station shall be made in fee simple to the state of Ohio, with covenants of seizin and warranty, and no title shall be taken to the state for purposes aforesaid until the attorney general shall be satisfied that the same is free from all defects and incumbrances. The attorney general shall be the legal adviser of said board of control, and shall institute and prosecute all suits in behalf of the same.

SECTION 2. Said original sections 409-2, 409-3, 409-4, 409-5 and 409-6 of the Revised Statutes of Ohio are hereby repealed and this act shall take effect and be in force from and after its passage.

W. S. MCKINNON,
Speaker of the House of Representatives.

CARL L. NIPPERT,
President of the Senate.

Passed February 18, 1902.

Under authority of this law, on February 26th you appointed the following persons as members of the Board of Control, for the terms stated:

FRIEND WHITTLESEY, of Atwater, Portage Co.,.....1 year.
ALVA AGEE, of Cheshire, Gallia Co.,.....2 years.
D. D. White, of Castalia, Erie Co.,.....3 years.
O. E. BRADFUTE, of Xenia, Greene Co.,.....4 years.
D. L. SAMPSON, of Cincinnati, Hamilton Co.,.....5 years.

The Board met at Columbus on March 3rd, and organized by the election of Alva Agee as president, O. E. Bradfute as secretary and D. L. Sampson as treasurer. The next day the board visited the Experiment Station, and after careful examination of its affairs re-elected Charles E. Thorne as director, and at a later meeting confirmed his appointments of members of staff, assistants and employes, this action throughout being taken by unanimous vote of the board.

At the meeting of March 4th the following resolution was unanimously adopted:

"Resolved that we respectfully urge the Ohio State Board of Agriculture to join with us in our efforts to secure the passage of House Bill No. 317 and such other kindred legislation as tends to place the enforcement of laws relative to the diseases of plants and animals in charge of the State Board of Agriculture, rather than with the Experiment Station."

This resolution was adopted with the feeling that the only legitimate work of an Agricultural Experiment Station is that of research in agriculture, and that whenever police duties of any sort are laid upon such an institution its proper work is interfered with.

The State Board of Agriculture reciprocated this feeling, and the result was the transfer to that body by the General Assembly of the work of orchard and nursery inspection, with which work the Experiment Station had hitherto been charged. A further action by the General Assembly transferred the powers and duties of the Live Stock Commission to the State Board of Agriculture, and in view of this action the Experiment Station discontinued the tuberculin testing of cattle, which it had carried on for two years previously, that work being assumed by the Board of Agriculture.

In these matters the two organizations have worked together in the most perfect harmony, and we feel that a very important advance has been made for the agriculture of the State in thus clearly drawing the line between those functions concerned in the execution of law and those concerned with scientific investigation.

APPROPRIATIONS.

The following appropriations were made to the Station by the General Assembly for the years 1902 and 1903:

	1902	1903
Expenses of Board of Control, unexpended balance and	$250 00	$500 00
Bulletin illustration	400 00	400 00
Special work in entomology, botany, chemistry and horticulture	7,000 00	7,000 00
Sub-stations for field experiments	5,000 00	5,000 00

General repairs, labor and supplies.....	7,000 00	7,000 00
Investigation of tuberculosis and other diseases of cattle (balance reappropriated).....	3,359 19	
Special work in animal industry.....	1,500 00	1,500 00
Library equipment and care.....	250 00	500 00
General construction.....	.....	3,000 00
Totals.....	$24,759 19	$24,900 00

These appropriations provide for the continuance and extension of the special work in entomology, botany, chemistry and horticulture, through which the Station has been enabled to carry its work into localities in which have occurred particularly destructive outbreaks of insect pests, or in which special problems in diseases of fruit trees or vines have presented themselves, and also for the extension of the soil studies of the Station through its sub-station work.

Hitherto Southern Ohio has been practically unrepresented in the Station's work, the main station and both sub-stations being located in the northern section of the State. But in no part of the State is the help of the Station more urgently needed than in the hill counties of southern and southeastern Ohio. Many of the leading problems which confront the farmers of this region are radically different from those on the level lands of the State, and they are problems which can only be studied on the ground. It is therefore proposed to establish two new sub-stations in Southern Ohio, one to be located in the Miami Valley and to have for a part of its work the study of questions pertaining to the cultivation of tobacco, and the other to be located at some point in the hill region of southeastern Ohio. Some of the problems before this southeastern sub-station will be the re-afforesting of the denuded hillsides which are too steep for profitable cultivation; the clothing of others with orchards, and of still others with pasture grasses.

It should be understood that these outlying sub-stations are merely test farms on which local conditions are studied under the supervision of the experts of the central station, to which all work requiring technical or laboratory investigation is transferred. Their cost of maintenance, therefore, is relatively small, as they require neither costly buildings nor expensive superintendence.

It will be observed that the plans above outlined contemplate a material enlargement of the Station's operations. This enlargement is being made in response to urgent demand on the part of the farmers of different sections for assistance in the solution of their special problems.

O. E. BRADFUTE,
Secretary of the Board of Control.

REPORT OF THE BURSAR.

MR. ALVA AGEE, *President of the Board of Control,*

SIR:—I respectfully submit herewith the financial report of this Station for the fiscal year ending June 30, 1902.

In Statements A, B, C and D, respectively, will be found a record of the receipts and expenditures from the various funds; Statement A being a statement of account with the annual appropriation received from the U. S. Treasury, and a copy of the report made to the Governor of the State, the Secretary of Agriculture, and the Secretary of the U. S. Treasury; Statement B being a statement of account with the State Treasury; and Statement C showing the receipts from farm produce and other sources and expenditures from this fund.

The three statements, A, B and C, are combined in Statement D, which shows the total income and expenditures for the fiscal year.

STATEMENT A.

THE OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION. 1901–1902.

Dr.

To receipts from the Treasurer of the United States, as per appropriation, for the fiscal year ending June 30, 1902, as per act of Congress approved March 2, 1887	$15,000 00

Cr.

By expenditures for—		
Salaries	$12,102 63	
Labor	585 92	
Postage and stationery	179 12	
Freight and express	15 62	
Heat, light, water and power	312 06	
Seeds, plants and sundry supplies	646 06	
Fertilizers	175 45	
Feeding stuffs	379 83	
Library	52 55	
Tools, implements and machinery	388 47	
Furniture and fixtures	79 22	
Contingent expenses	15 00	
Buildings and repairs	68 07	
		$15,000 00

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Ohio Agricultural Experiment Station for the fiscal year ending June 30, 1902; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000.00, and the corresponding disbursements $15,000.00; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

{ SEAL OF INSTITUTION. }

Signed:

FRIEND WHITTLESEY,

O. E. BRADFUTE,

Auditors of Board of Control.

Attest: CHAS. E. THORNE, *Custodian.*

I hereby certify that the foregoing statement of account to which this is attached, is a true copy from the books of account of the institution named.

W. H. KRAMER, *Bursar.*

STATEMENT B.

OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE STATE TREASURY.

Date of appropriation.	Appropriation for—	Total amount to Station's credit.	Total amount expended.	Balance in treasury June 30, 1902
1902	Sub-stations for field experiments.....	$5,000 00	$ 785 95	$4,214 05
	Bulletin illustration.....	400 00	.....	400 00
	Special work in entomology, botany, horticulture and chemistry.....	7,000 00	1,081 69	5,918 31
	General repairs, labor and supplies...	7,500 00	557 62	6,942 38
	Special work in animal industry.....	1,500 00	....	1,500 00
	Library equipment and care.....	250 00	.....	250 00
	Expenses of Board of Control.....	250 00	250 00	.....
	Totals for 1902.....	**$21,900 00**	**$2,675 26**	**$19,224 74**
	Balance of appropriations for 1900 and 1901 brought forward July 1, 1901.			
1900	New construction.....	$ 850 00	$ 850 00	....
	Investigation of tuberculosis and other diseases of cattle.....	1,635 99	1,276 80	359 19
	Bulletin illustration.....	96	96	.....
	Expenses of Board of Control.....	40 73	40 73	.....
1901	Sub-stations for field experiments.....	1,677 94	1,677 94	.....
	Bulletin illustration.....	400 00	400 00	.....
	Special work in entomology, botany, horticulture and chemistry.....	3,237 77	3,237 77	.....
	General repairs, labor and supplies...	510 71	510 71	.....
	Investigation of tuberculosis and other diseases in cattle.....	3,000 00	.....	* 3,000 00
	Expenses of Board of Control.....	700 00	700 00	.....
	Totals for 1900-1902.....	**$33,954 10**	**$11,370 17**	**$22,583 93**

*Reappropriated for 1902-1903.

STATEMENT C.

Ohio Agricultural Experiment Station in Account with Produce Fund.

To Receipts.

June 30, 1902.			
From sales of agricultural produce	$1,339 19		
" dairy produce	855 75		
" live stock	2,819 29		
" horticultural produce	2,142 32		
Northeastern Sub-station produce	141 48		
Northwestern Sub-station produce	118 55		
O. S. U. Sub-station produce	73 23		
Total produce		$7,489 81	
labor		112 83	
rents		673 18	
miscellaneous sales		537 21	
fees for testing dairy cattle (milk test)		324 80	
Total receipts for the year			$9,137 83
Balance brought forward July 1, 1901			1,356 77
Total			**$10,494 60**

By Expenditures.

June 30, 1902.			
For Salaries, special and temporary services		15 00	
labor		6,117 85	
postage and stationery		112 46	
freight and express		219 13	
heat, light, water and power		129 17	
seeds, plants and sundry supplies		467 55	
fertilizers		39 30	
feeding stuffs		482 34	
library		17 94	
tools, implements and machinery		72 67	
furniture and fixtures		76 48	
live stock		935 46	
traveling expenses		149 52	
contingent expenses		89 47	
buildings and repairs		164 62	
miscellaneous		335 82	
Total expenditures for the year			$9,424 78
By balance carried forward			1,069 82
Total			**$10,494 60**

STATEMENT D.

TOTAL RECEIPTS AND EXPENDITURES OF THE OHIO AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING JUNE 30, 1902.

Total Receipts.

From U. S. Treasury		$15,000 00
State appropriations		21,900 00
miscellaneous receipts		9,137 83
Total receipts for the year		$46,037 83
To balance brought forward July 1, 1901		13,410 87
Total		**$59,448 70**

Total Expenditures.

For salaries and wages: technical and office staff		$13,021 40
special and temporary services		15 00
foremen and skilled laborers	$4,031 63	
ordinary loborers	7,264 55	
Total labor		11,296 18
publications		451 37
postage and stationery		561 47
freight and express		334 12
heat, light, water and power		769 59
chemical supplies		176 32
seeds, plants and sundry supplies		1,706 22
fertilizers		348 89
feeding stuffs		872 17
library		153 98
tools, implements and machinery		605 91
furniture and fixtures		168 81
scientific apparatus		14 07
live stock		1,060 46
traveling expenses		2,198 97
contingent expenses		449 59
buildings and repairs		1,254 61
miscellaneous		335 82
Total expenditures for the year		$35,794 95
By balance carried forward		23,653 75
Total		**$59,448 70**

Respectfully submitted,

W. H. KRAMER, *Bursar.*

REPORT OF THE DIRECTOR.

MR. ALVA AGEE, *President of the Board of Control:*

SIR: The past year has been an eventful one in the history of this Station. For nearly twenty years it had prospered under an organic law whose provisions had purposely been made as simple as possible, in order not to fetter its growth. So long as the Station was kept strictly to its legitimate work of research this loosely framed law served its purpose well; but with the growth in influence and usefulness of the Station came the temptation to use its organization for purposes, proper and legitimate in themselves, but altogether foreign to the work of scientific research. This attempt gave rise to conflicting interests, and misunderstandings arose both within and without the Station; the organic law was found to be susceptible of interpretations diametrically opposite to those under which it had hitherto been construed, and thus a recasting of the law became imperative.

On the assembling of the legislature the Governor directed attention to this matter, and on the enactment of a new law, framed along lines suggested by him, he appointed a Board of Control consisting exclusively of actual farmers, and the legislature manifested its confidence in this Board by making larger appropriations for the research work of the Station than had ever before been made for that purpose in the State.

THE WORK OF THE YEAR.

The investigations of the Station during the year under review have followed closely along the lines previously laid down, and while this method may not result in many new discoveries, we feel that the stability which it affords to the few conclusions reached is ample justification for its continuance. A part of the work done during the year is reported in the following bulletins:

No. 129, pp. 1–28: By J. Fremont Hickman: Field experiments with wheat; comprising comparison of varieties and cultural investigations. In the variety comparisons, extending over nine

seasons at Wooster and following, in some cases, a considerable period at Columbus, we find that a few sorts have taken and maintained a considerable lead in productiveness over other sorts. The cultural investigations indicate for thin soils a decidedly larger quantity of seed per acre than is usually sown.

Bulletin 130, pp. 29–46: By A. D. Selby: Spraying for grape rot and the relation of spraying to public health. This bulletin reports a coöperative experiment in spraying in a commercial vineyard, in which a very large increase of crop and of net profit resulted from spraying. It also gives evidence showing that there is no danger to health in the use of grapes which have been properly sprayed.

Bulletin 131, pp. 41–52: By A. D. Selby: The prevention of onion smut. This bulletin reports progress in a series of experiments reported previously in Bulletin 122, and shows that the use of formalin or quicklime is fully warranted for prevention of this trouble.

Bulletin 132, pp. 53–70: By John W. Ames: Sugar beet investigations in 1901. This bulletin reports a continuance of work previously reported. It gives the analyses of 216 samples of sugar beets sent from different parts of the State.

Bulletin 133, pp. 71–88: By W J. Green and C. W. Waid: Potatoes: Comparison of varieties and fertilizer tests. This bulletin is a report of progress in these lines and gives information concerning the productiveness and quality of 55 varieties of potatoes and a summary of 8 years' experiments with different combinations of fertilizing materials.

Bulletin 134, pp. 89–102: By C. E. Thorne and J. Fremont Hickman: The value of barnyard manure: containing data on the composition of manure and the results of experiments in the re-enforcement of manure, in the comparison of open-yard with stall manure, and in comparison of manure with commercial fertilizers, eing a continuance of the investigations of the Station on the mainenance of fertility, previously reporte

Bulletin 135, pp. 103–140: By C. A Patton: Meteorological summary, press bulletins and index· this bulletin is appended to the present report.

These bulletins contain only a small part of the Station's work for the year. Several others are in process of preparation, but the company having secured the contract for this part of the State printing for two years, 1901 and 1902, have been occupying from 2

to 4 months in getting out one of our small bulletins, so that it has been useless to attempt to issue any bulletin, the value of which depended upon prompt publication. I am happy to be able to report that the last General Assembly has made an appropriation for the Station to cover the cost of a printing outfit, and as soon as the present printing contract expires the outfit will be installed and the bulletins will be printed in the Station's own office and under its own control.

Press Bulletins have also been issued during the year, carrying this series to No. 239. These bulletins are republished in Bulletin No. 135, appended to the present report.

ACKNOWLEDGMENTS.

The following publications have been received during the year as donations to the Station's library, or in exchange for its bulletins:

BOOKS, PAMPHLETS AND SCIENTIFIC PERIODICALS.

AUSTRALIA: Reports of the Minister of Agriculture for South Australia for 1900 and 1901: Richard Butler, Minister of Agriculture, Adelaide, South Australia.

——Report of the Botanical Gardens and Domains of New South Wales, for 1900: J. H. Maiden, Director, Sydney.

BARBADOES: Report of the Agricultural Work for the seasons between 1899–1901, carried on under the direction of the Imperial Department of Agriculture for the West Indies: J. R. Bovell, F. C. S., F. L. S., Superintendent of Botanical Station, Dodds Reformatory.

BRAZIL: Brazilian Coccidæ: Prof. A. Hempel, S. Paulo, Brazil.

——Revista do Museu Paulista, 1900: por H. Von Ihering, S. Paulo.

BUENOS AIRES: Anales del Museo Nacional, tomo VII, 1902: Florentino Ameghino, Director, Buenos Aires.

——Communicaciones del Museo Nacional de Buenos Aires, 1898–1901: Prof. Dr. Carlos Berg, Buenos Aires.

BELGIUM: Bulletin de l' Institut Chimique et Bacteriologique de l' Etat a Gembloux.

CANADA: Report of the Department of Agriculture of the Northwest Territories for 1900: G. H. V. Bulyea, Commissioner of Agriculture, Regina, Canada.

——Ontario Department of Agriculture: Reports of the Agricultural College and Experimental Farm; Experimental Union; Live Stock Associations; Registrar of Live Stock; Farmers' Institutes; Bee Keepers' Association; Poultry Association; Fruit Growers' Association; Fruit Experiment Station and bulletins of the Agricultural College and Bureau of Industries: Hon. John Dryden, Minister, Toronto.

CEYLON: Royal Botanic Gardens: Report of the Director for 1901. J. C. Willis, M. A., Director, Peradeniya, Ceylon.

COSTA RICA: Boletin del Instituto Fisico-Geografico de Costa Rica: Senor Don Manuel Aragon, Director General de Estadistica, San José, Costa Rica.

DENMARK: Oversigt over det Konelige Danske Videnskabernes Selskabs Forhandlinger, 1892–1900, 10 vols.: H. G. Zeuthen, Sekretær, Copenhagen.

ENGLAND: Annual Report on the Distribution of Grants for Agricultural

Education and Research in the year 1900–1901: Secretary to the Board of Agriculture, London.

——Durham College of Science, New Castle-upon-Tyne: Experiments with crops and stock conducted by the agricultural department during the season of 1901: Compiled by Prof. T. H. Middleton, M. A., M. Sc.

——Journal of the Royal Horticultural Society: Rev. W. Wilks, M. A., Secretary, 117 Victoria St., London, S. W.

——Lawes Agricultural Trust: Memoranda of the origin, plan and results of the field and other experiments conducted on the farm and in the laboratory of the late Sir John Bennett Lawes, Bart., D. C. L., LL. D., F. R. S., at Rothamsted, Herts, England, for 1901.

——Prospectus of the Aynsome Agricultural Experiment Station and farm: J. S. & T. M. Remington, proprietors, Cartmell, Grange-over-Sands, Lancashire.

——Victoria University, The Yorkshire College, Leeds: 27th Annual Report, 1900–1901.

FINLAND: Berattelse ofver Skadeinsekters Upptradande i Finland, ar 1899–1900: Afgifoen af Enzio Reuter, Helsingfors, 1900–1901.

——Physopus tenuicornis Uzel als Erzeuger totaler Wessahigheit bei Hafer: von Enzio Reuter, Helsingfors.

——Rhizoglyphus echinopus (Fum. et Murray) ein neuer Schadiger des Hafers: von Enzio Reuter, Helsingfors.

FRANCE: Les Pieges lumineux et la destruction des insectes nuisibles: V. Vermorel, Montpelier.

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Bi-Weekly Taxpayer, Woodsfield.
Cumberland Echo, Cumberland.
Fremont Journal, Fremont.
Gazette, Ashland.
Greenville Democrat, Greenville.
Hanoverton Record, Hanoverton.
Hardin County Republican, Kenton.
Jacksonian, Wooster.
News Democrat, Georgetown.
Ohio Democrat and Times, New Philadelphia.
Ohio State Journal, Columbus.
Preble County News, Camden.
Reveille Echo, East Palestine.
Salineville Observer, Salineville.
Saturday Whetstone, Barnesville.
Semi-Weekly Gazette, Delaware.
Sugar Creek Budget, Sugarcreek.
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Tipp Herald, Tippecanoe City.
Tuscarawas Chronicle, Uhrichsville and Dennison.
Uhrichsville Chronicle, Uhrichsville.
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Kansas Semi-Weekly Capital, Topeka, Kan.
New Castle Tribune, New Castle, Pa.
Orilla Packet, Orilla, Ontario, Canada.
Republic. St. Louis, Mo.
Salt Lake Herald, (Semi-weekly), Salt Lake City, Utah.

The Station is also under obligation for the following favors:

Bartelder & Co., F., Lawrence, Kansas; eight packages seed.
Burpee & Co., W. Atlee, Philadelphia, Pa.; forty packages seed.
Cary, A. L., Lewis, Morgan Co., Ohio; three quarts seed corn.

Chilean Nitrate Works, William S. Myers, Director of Propaganda, 12 John Street, N. Y. City; 3000 pounds nitrate Soda.
Clifford, Frank, Wellington, Ohio; one peck seed wheat.
Dirk, J. V., Wingston, Ohio; three quarts corn.
Garretson, Amos, Pendleton, Ind; two dozen Eaton rasbberry plants.
Henderson & Co., Peter, N. Y. City; thirty-five packages seeds.
Hardie Spray Pump Co., Detroit Mich.; one spray pump.
Hubbel, N. S., West Toledo, Ohio; one variety plum, native.
Latham & Co., Sandusky, O.; spray nozzles.
Lonsinger, C. L., Bluff, Ohio; three quarts corn.
March, H. A., Fidalgo, Washington; six packets seed.
McCormick, C. H., McCormick, Ohio; three quarts corn.
Millet, J. W., Bismark, N. D.; Dakota Ironclad strawberry plants.
Parker & Co., J. E., Eaton, O.; one peck seed wheat.
Scott, Geo. E., Mt. Pleasant, Ohio; three quarts corn.
Schroeder, Wm. T., Fredericktown, Ohio; three quarts corn.
Sutliff, C. W., Norwalk, Ohio; one peck wheat.
Stearns, Elmer, Los Angeles, Cal.; five packages seed.
Stark Nurseries, Louisiana, Mo.; one peach, select seedling, and one grape seedling.

Respectfully submitted,

CHAS. E. THORNE, Director.

BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 135. JUNE, 1902.

METEOROLOGICAL SUMMARY—PRESS BULLETINS—INDEX.

METEOROLOGICAL SUMMARY FOR 1901.

BY C. A. PATTON.

EXPLANATION OF TABLES.

The following tables contain statistics of temperature, rainfall, etc., for the year, and are compiled from data obtained by daily observations. "T" stands for "trace"—less than .01 inch of rainfall. Temperature is given in degrees Fahrenheit.

Table I shows the daily rainfall at the Station during the year in inches and hundredths.

Table II shows the daily mean temperature for each day of 1901, the monthly mean temperature with the fourteen years' average.

Table III gives a comparison of the monthly mean temperature and rainfall for the Station, with the fourteen years' average for the same.

Table IV gives a comparison of the monthly mean temperature and rainfall for the State, with the fourteen years' average for the same.

Table V gives the monthly mean temperature and rainfall for the Station and State for 1901, with the fourteen years' average for the same.

Table VI contains the mean temperature, the highest and the lowest temperatures, with the range of temperature for each month; the number of clear, fair and cloudy days; the rainfall, snowfall and prevailing direction of wind, for the Experiment Station, 1901.

Table VII contains the principal points of interest on temperature, state of weather and rainfall for the Station during the year and a grand summary for fourteen years.

Table VIII contains the principal points of interest on temperature, state of weather and rainfall for the State during the year and a grand summary for nineteen years.

The statistics for the State and for this Station previous to 1893 are compiled from the publications of the Ohio Meteorological Bureau and State Weather Service, the fourteen years' average being computed from the observations of the Wooster Station of the Ohio Meteorological Bureau, now located on the grounds of the Experiment Station, one mile south of Wooster.

NOTES ON THE WEATHER AT THE STATION, 1901—SUMMARY BY MONTHS.

JANUARY.

The mean temperature for January was 28.3° which is .9° above the Station average for January. The highest, 53°, occurred on the 10th; the lowest, —.4°, on the 2nd. Cloudy weather prevailed. Rain or snow fell on sixteen days. The total precipitation was 1.58 inch, which is 1.59 inch below the Station average for January. The prevailing wind was southwest.

FEBRUARY.

The mean temperature for February was 20°, which is 7.2° below the Station average for February. The highest temperature, 40°, occurred on the 16th. The lowest, 0°, on the 2nd. Cloudy weather prevailed. Rain or snow fell on eight days. The total precipitation was 1.20 inch, which is 1.80 inch below the Station average for February. The prevailing wind was southwest.

MARCH.

The mean temperature for March was 39.1°, which is 3.5° above the Station average for March. The highest, 69°, occurred on the 25th; the lowest, —1°, on the 6th. Cloudy weather prevailed

Rain or snow fell on sixteen days. The total precipitation was 3.09 inches, which is .15 inch below the Station average for March. The prevailing wind was southwest.

APRIL.

The mean temperature for April was 45.2°, which is 3.4° below the Station average for April. The highest temperature, 82°, occurred on the 30th; the lowest, 22°, on the 1st. Cloudy weather prevailed. Rain or snow fell on fifteen days. The total precipitation was 2.46 inches, which is the average rainfall for April. The prevailing wind was north.

MAY.

The mean temperature for May was 57.9°, which is the average temperature for May. The highest temperature, 82°, occurred on the 2nd; the lowest, 33°, on the 4th. Cloudy weather prevailed. Rain fell on eighteen days. The total precipitation was 4.32 inches, which is .12 inch above the Station average for May. The prevailing wind was north.

JUNE.

The mean temperature for June was 69.1°, which is 1° above the Station average for June. The highest temperature, 91°, occurred on the 25th, 27th, 29th and 30th; the lowest, 38°, on the 3rd and 9th. Fair weather prevailed. Rain fell on sixteen days. The total precipitation was 4.82 inches, which is .76 inch above the Station average for June. The prevailing wind was northeast.

JULY.

The mean temperature for July was 75.9°, which is 4.7° above the Station average for July. The highest temperature, 95°, occurred on the 1st, 22nd, 28th and 29th; the lowest, 50°, on the 9th. Clear weather prevailed. Rain fell on ten days. The total precipitation was 3.32 inches, which is .85 inch below the Station average for July. The prevailing wind was southwest.

AUGUST.

The mean temperature for August was 71.6°, which is 2.3° above the Station average for August. The highest, 94°, occurred on the 9th; the lowest, 47°, on the 5th. Clear weather prevailed. Rain fell on ten days. The total precipitation was 3.58 inches, which is .61 inch above the Station average for August. The prevailing wind was south.

SEPTEMBER.

The mean temperature for September was 63.3°, which is 1° below the Station average for September. The highest temperature, 86°, occurred on the 5th and 7th; the lowest, 34°, on the 19th. Clear weather prevailed. Rain fell on eight days. The total precipitation was 5.64 inches, which is 2.35 inches above the Station average for September. The prevailing wind was south.

OCTOBER.

The mean temperature for October was 51.7°, which is 1.2° above the Station average for October. The highest temperature, 79°, occurred on the 23rd; the lowest, 26°, on the 5th. Clear weather prevailed. Rain fell on five days. The total precipitation was .81 inch, which is 1.58 inch below the Station average for October. The prevailing wind was south.

NOVEMBER.

The mean temperature was 36.6°, which is 3.1° below the Station average for November. The highest temperature, 67°, occurred on the 3rd; the lowest, 15°, on the 28th. Cloudy weather prevailed. Rain or snow fell on eleven days. The total precipitation was 1.62 inch, which is 1.75 inch below the Station average for November. The prevailing wind was northwest.

DECEMBER.

The mean temperature for December was 26.1°, which is 5.2° below the Station average for December. The highest temperature, 64°, occurred on the 13th; the lowest, —11°, on the 21st. Cloudy weather prevailed. Rain or snow fell on nine days. The total precipitation was 3.47 inches, which is 1.02 inch above the Station average for December. The prevailing wind was southwest.

METEOROLOGY—TABLE I.—RAINFALL.

DAILY RAINFALL AND MELTED SNOW FOR 1901 AT EXPERIMENT STATION.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Date.
1	.....	.....	.05	.....	.....	.15	.....	T	.27	.....	T	.....	1
2	.....	.....	.38	.03	T	.06	.....	T	T	.05	.....	.04	2
3	.....	.50	.04	.20	.10	.....	.65	.....	.....	.....	.....	.....	3
4	.....	.35	.03	.04	.....	.....	.40	.....	.....	.....	.57	.....	4
5	.....	T	.10	.07	.....	.40	.30	.....	.....	.....	.....	.....	5
6	.....	T	.....	.20	T	.72	.....	.02	.....	.....	.....	.....	6
7	.04	.....	.....	.03	.47	.....	.....	.....	.....	.....	.....	T	7
8	.04	.....	T	.....	.62	.....	.02	T	.....	.....	.....	T	8
9	.26	.17	1.15	.....	.02	.....	.....	.....	.....	.....	.....	1.10	9
10	.34	.....	.09	.....	.08	.....	.....	T	1.03	.04	.....	.36	10
11	.30	.10	.04	.....	.08	1.40	.....	.....	.04	.....	.13	.....	11
12	.04	T	.....	.....	.08	T	.....	.....	.17	T	.38	.....	12
13	.....	.02	.17	.05	.....	.03	.....	.....	T	.04	.01	.02	13
14	.13	.....	.02	.05	.....	T	.....	.....	.....	.....	.05	1.40	14
15	.....	.....	T	T	.....	.28	.26	.52	1.40	.....	.10	.10	15
16	.....	.....	.....	.....	.....	.02	T	.....	.....	.12	.05	.....	16
17	T	.02	.....	T	.....	.25	.82	.06	.57	.56	T	.....	17
18	.02	.....	.....	.05	.34	T	.02	.74	.....	T	.02	.....	18
19	.07	T	.....	.54	.19	.05	.....	.64	.....	.....	.....	.....	19
20	.....	.02	.42	.86	.34	.64	.....	.20	.....	.....	.....	.....	20
21	T	.....	.02	.24	.33	.06	.....	.....	.....	.....	.....	.....	21
22	.....	T	.....	.02	.12	.02	.....	.14	.....	.....	.....	.....	22
23	.06	T	.....	T	.....	.24	.....	.39	.....	.....	T	.02	23
24	.04	T	.30	.06	.02	.....	.....	.....	.....	.....	.25	T	34
25	.02	.02	.20	.02	T	.46	T	.....	.....	.....	.04	.05	25
26	.05	T	.03	.....	.18	.....	.36	.....	.....	.....	T	T	26
27	.07	T	.05	.....	.30	.....	.....	.....	.....	.....	T	.....	27
28	.....	.....	T	.....	.80	.04	.....	.....	1.67	.....	.00	.....	28
29	.05	.....	.....	.....	.01	T	.45	.....	.49	.....	.02	.38	29
30	.05	.....	T	.....	.....	T	.....	.70	.....	.....	.....	.....	30
31	.....	.....	.....	.....	.24	.....	.04	.17	.....	.....	.....	.....	31
Totals	1.58	1.20	3.09	3.46	4.32	4.82	3.32	3.58	5.64	0.81	1.62	3.47	
Averages	.05	.04	.10	.08	.14	.16	.11	.12	.19	.03	.05	.11	

METEOROLOGY—TABLE II.—TEMPERATURE.

MEAN TEMPERATURE FOR EACH DAY OF 1901 AT THE STATION.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Date.
1	23.0	16.5	25.0	36.0	67.0	56.5	84.0	69.5	64.0	56.0	54.0	45.0	 1
2	9.0	14.0	35.5	40.0	69.5	57.5	79.0	64.5	67.0	57.5	41.0	42.0	 2
3	10.5	28.0	48.0	39.5	59.0	53.5	79.0	72.5	68.5	45.5	49.5	31.0	 3
4	22.5	31.0	43.0	42.0	51.0	60.0	78.0	64.5	69.5	41.5	43.5	20.0	 4
5	27.0	18.5	26.0	41.0	55.0	69.0	78.0	63.0	71.0	42.5	32.0	19.0	 5
6	23.5	15.5	18.5	45.0	60.0	70.0	76.0	65.5	70.0	43.5	31.0	23.0	 6
7	34.5	12.0	24.0	43.0	63.5	60.0	67.0	71.5	71.5	45.5	44.5	33.0	 7
8	38.0	21.0	35.0	38.0	60.5	52.0	64.0	76.0	70.0	55.5	42.0	41.0	 8
9	41.5	27.0	39.0	41.5	63.0	54.0	65.0	75.5	62.5	59.5	41.0	40.5	 9
10	43.5	21.5	45.0	41.0	62.5	60.0	72.5	78.0	65.5	62.5	35.0	28.5	10
11	40.0	20.5	41.0	41.5	60.0	69.5	75.5	65.5	65.5	58.0	48.5	31.0	11
12	31.0	21.0	36.0	44.5	55.5	74.5	68.5	67.5	73.0	65.5	48.0	34.5	12
13	29.5	11.5	46.5	49.5	47.0	77.5	70.5	68.0	65.5	57.0	38.0	50.5	13
14	33.0	13.0	38.0	45.5	56.0	72.0	76.0	73.5	60.5	44.0	42.0	42.5	14
15	41.0	18.0	29.5	44.5	51.5	72.5	77.5	72.0	68.5	45.0	28.5	12.5	15
16	42.0	28.0	27.5	46.0	54.0	71.0	80.5	73.5	65.5	52.0	30.0	—.5	16
17	29.0	28.0	41.0	60.0	59.5	70.0	77.5	74.0	56.0	42.0	31.5	10.5	17
18	18.0	34.5	49.0	49.0	61.5	69.5	79.0	77.5	50.0	40.5	32.5	7.0	18
19	15.0	23.5	57.5	38.5	56.5	72.0	72.5	76.0	47.0	55.0	30.5	4.0	19
20	28.0	16.0	46.5	31.0	58.5	71.0	72.0	76.0	51.5	48.0	34.0	2.0	20
21	39.0	14.5	29.5	33.5	58.5	73.5	77.0	78.0	51.0	46.0	36.0	—1.0	21
22	33.5	13.5	36.0	39.0	65.5	73.5	82.5	76.0	58.0	56.0	36.0	17.0	22
23	36.0	11.0	49.0	44.5	63.0	74.5	72.0	74.0	62.5	66.5	38.5	32.0	...23
24	34.0	12.0	49.0	48.0	69.5	73.5	74.0	75.0	65.5	55.5	35.0	33.5	24
25	24.0	27.5	61.0	53.0	56.0	79.5	77.5	67.0	64.0	43.0	34.0	35.0	25
26	21.5	23.5	53.5	55.0	50.0	76.0	77.0	69.0	66.0	47.5	28.0	32.5	26
27	27.0	15.5	40.5	56.0	52.0	77.5	81.5	73.0	64.0	50.0	25.0	33.0	27
28	23.0	24.5	34.5	58.0	51.0	78.0	83.5	72.0	59.0	49.0	22.5	31.5	28
29	19.5	.....	34.0	52.5	50.0	79.5	84.5	75.0	66.0	56.5	31.5	31.5	29
30	23.5	.....	34.5	60.5	54.0	76.0	79.0	72.5	61.0	59.0	35.0	32.5	30
31	16.5	.....	37.5	.....	55.5	.....	71.5	64.5	.....	58.5	.....	33.5	31
Monthly mean..	28.3	20.0	39.1	45.2	57.9	69.1	75.9	71.6	63.3	51.7	36.6	26.1	
14-year average.	**27.4**	**27.2**	**35.6**	**48.6**	**57.9**	**68.1**	**71.2**	**69.3**	**63.4**	**50.5**	**39.7**	**31.3**	

METEOROLOGY—TABLE III.

MONTHLY MEAN TEMPERATURE AND RAINFALL FOR FOURTEEN YEARS AT WOOSTER.

Temperature in degrees Fahrenheit.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Date.
1888.....	23.0	28.4	31.7	46.3	57.7	68.9	70.1	67.8	57.1	44.9	40.7	31.4	47.3	1888
1889.....	31.1	22.9	38.7	47.1	57.8	64.5	70.0	66.0	60.8	45.3	39.3	40.7	48.6	1889
1890.....	36.0	36.6	30.9	48.4	56.0	69.8	70.5	65.8	59.6	50.0	41.3	28.8	49.5	1890
1891.....	30.0	34.0	32.0	49.0	52.0	68.0	68.0	71.0	68.0	49.0	38.0	37.0	49.6	1891
1892.....	22.0	33.0	33.0	47.0	57.0	70.0	70.0	69.0	61.0	49.0	38.0	28.0	48.0	1892
1893.....	18.0	28.0	38.0	50.1	57.6	69.3	72.0	67.9	63.2	52.3	37.7	30.9	48.7	1893
1894.....	32.8	26.7	43.5	50.5	57.5	67.9	71.4	69.2	66.1	52.3	36.5	32.9	50.6	1894
1895.....	21.9	17.9	32.4	49.5	59.4	69.9	68.6	70.9	66.5	44.2	40.4	32.8	47.8	1895
1896.....	27.9	29.2	29.8	54.6	64.5	65.6	70.2	68.5	60.6	45.8	44.4	30.6	49.3	1896
1897.....	24.0	30.0	39.3	47.2	53.4	64.3	73.2	67.0	66.7	55.9	40.7	31.8	49.4	1897
1898.....	31.6	27.4	43.3	45.3	58.2	68.7	74.5	71.1	66.2	52.6	38.4	27.9	50.4	1898
1899.....	26.6	21.3	35.0	52.1	60.0	69.4	70.0	71.0	61.6	55.0	43.2	29.0	49.5	1899
1900.....	30.2	25.0	31.8	47.8	61.5	68.5	72.6	74.0	67.1	58.9	40.6	30.7	50.7	1900
1901.....	28.3	20.0	39.1	45.2	57.9	69.1	75.9	71.6	63.3	51.7	36.6	26.1	48.7	1901
Averages.	**27.4**	**27.2**	**35.6**	**48.6**	**57.9**	**68.1**	**71.2**	**69.3**	**63.4**	**50.5**	**39.7**	**31.3**	**49.1**	

Rainfall—Inches.

1888.....	3.52	2.43	3.34	2.48	3.82	2.31	4.54	4.35	1.92	3.18	4.95	1.39	3.18	1888
1889.....	4.33	2.42	2.13	1.58	2.97	4.86	6.73	1.98	4.05	1.36	3.53	3.93	3.32	1889
1890.....	4.71	6.20	4.37	3.10	6.01	5.57	2.67	4.66	5.12	7.45	2.61	1.74	4.51	1890
1891.....	2.74	4.83	3.71	1.66	2.24	7.13	3.28	1.85	0.94	1.33	5.73	2.92	3.20	1891
1892.....	2.67	2.67	3.38	2.44	7.69	7.89	4.73	2.69	3.20	0.37	2.06	1.74	3.46	1892
1893.....	4.01	6.33	1.89	5.66	6.28	2.51	1.38	1.53	1.85	5.18	2.49	1.50	3.38	1893
1894.....	2.19	3.37	2.36	1.74	4.41	2.23	1.38	0.76	4.07	2.53	2.41	3.15	2.55	1894
1895.....	3.92	1.00	1.98	1.69	1.38	4.20	2.19	2.30	3.92	1.15	4.21	3.51	2.62	1895
1896.....	1.73	2.27	3.67	3.34	3.41	3.98	8.05	1.96	5.16	0.71	1.78	2.41	3.21	1896
1897.....	2.82	2.64	2.81	2.75	4.97	2.98	3.89	3.86	0.29	0.89	5.76	2.50	3.01	1897
1898.....	4.10	2.27	6.44	2.56	4.60	2.70	6.79	5.53	2.15	4.28	4.14	2.29	3.99	1898
1899.....	3.29	1.64	3.95	1.28	4.42	1.95	3.73	0.53	5.56	2.21	1.59	2.78	2.74	1899
1900.....	2.78	2.74	2.25	1.70	2.23	3.71	5.65	5.97	2.19	2.10	4.30	0.99	3.05	1900
1901.....	1.58	1.20	3.09	2.46	4.32	4.82	3.32	3.58	5.64	0.81	1.62	3.47	2.99	1901
Averages.	**3.17**	**3.00**	**3.24**	**2.46**	**4.20**	**4.06**	**4.17**	**2.97**	**3.29**	**2.39**	**3.37**	**2.45**	**3.23**	

METEOROLOGY—TABLE IV.

MONTHLY MEAN TEMPERATURE AND RAINFALL FOR FOURTEEN YEARS FOR THE STATE.

Temperature in degrees Fahrenheit.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Date.
1888	24 3	30.5	34.2	49.2	59.1	70.4	72.1	70.4	60.3	47.9	42.9	33.3	49.5	1888
1889	33.3	25.8	40.2	49.9	60.2	66.7	72.5	69.1	62 9	47.9	41.0	43.8	51.1	1889
1890	38.8	39.4	34.5	51.3	59.2	73.3	73.1	68.8	62.1	52.7	43.9	31.2	52.3	1890
1891	33.0	36.0	35.0	52.0	58.0	71.0	69.0	70.0	67.0	51.0	40.0	39.0	51.7	1891
1892	24.0	35.0	35.0	49.0	59.0	73.0	73.0	71.0	64.0	52.0	38.0	29.0	50.1	1892
1893	18.0	29.0	38.0	50.2	58.3	70.6	74.5	70.7	65.2	53.7	39.3	32.7	51.6	1893
1894	37.7	28.0	45.1	50.6	60.0	71.3	74.3	71.2	67.8	53.9	37.5	33.9	52.3	1894
1895	23.4	19.6	35.5	51.7	61.1	70.2	71.6	73.5	69.0	46.9	41.3	33.9	49.9	1895
1896	29.4	30.5	32 4	56.7	67.9	69.5	73.2	71.8	62.7	49.0	45.1	32.9	51.7	1896
1897	25.5	32.4	41.5	49.3	46.3	68.1	75.5	69.4	66.9	58.1	42.2	32.8	50.6	1897
1898	32.4	30.0	45.0	47.2	61.0	71.9	76 0	73.5	67.8	53.1	38.8	28.8	52.1	1898
1899	27.8	21.6	36.9	53.3	63.3	71.5	74.1	73.7	64.1	57.4	43.9	30.2	51.5	1899
1900	31.1	26.0	32.9	50.1	62.9	69.8	74.1	76.3	69.3	60.5	41.6	31.6	52.3	1900
1901	29.2	21.1	39 5	46.7	59.0	70.9	78.1	73.1	64.8	53.8	37.7	27.9	50.2	1901
Averages.	**29.1**	**29.0**	**37.6**	**50.5**	**59.7**	**70.6**	**73.7**	**71.6**	**65.3**	**52.7**	**40.9**	**32.9**	**51.2**	

Rainfall—Inches.

1888	3.65	1.74	3.55	1.99	3.77	3.41	4.40	5.16	2.27	3.98	4.25	1.47	3.30	1888
1889	3.13	1.35	1.50	1.79	3.71	4.13	4.25	1.50	3.62	1.78	4.02	2.81	2.79	1889
1890	4.94	5.25	5.29	3.15	5.52	4.50	1.99	4.70	5.56	4.27	2.53	2.37	4.17	1890
1891	2 82	4.91	4.19	2.13	2.20	4.82	3.82	3.07	1.50	1.76	5.00	2.39	3.21	1891
1892	2.05	3.27	2.16	2.63	4.63	6.73	3.13	6.15	1.27	0.67	2.62	1.85	3.09	1892
1893	2.56	5.13	2.09	6.37	4.97	3.34	2.49	2.17	1.57	4.24	2.09	2.61	3.30	1893
1894	2.14	2.79	2.16	2.31	4.00	2.65	1.56	1.67	3.31	2.01	2.17	2.98	2.47	1894
1895	4.00	0.69	1.59	2.11	1.80	2.44	2.00	2.96	1.66	1.22	4.11	3.85	2.37	1895
1896	1.67	2.25	3.34	2.78	2.67	4.81	8.11	3.38	5.13	1.20	2.63	1.65	3.29	1896
1897	1.93	3.64	5.17	3.27	3.93	2.85	4.65	2.72	0.78	0.64	6.62	2.39	3.21	1897
1901	1.70	1.24	2.66	3.40	3.96	4.38	2.73	3.32	2 86	0.73	1.54	3.79	2.69	1901
Averages.	**2.94**	**2.87**	**3.35**	**2.71**	**3.71**	**3.78**	**3.71**	**3.34**	**2.61**	**2.16**	**3.33**	**2.52**	**3.09**	

METEOROLOGY—TABLE V.

MEAN TEMPERATURE AND RAINFALL FOR THE STATION AND STATE, 1901, AND FOR FOURTEEN YEARS.

Temperature in degrees Fahrenheit. Rainfall in inches.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Mean temperature at the Station, 1901	2.83	20.0	39.1	45.2	57.9	69.1	75.9	71.6	63.3	51.7	36.6	26.1	48.7
Fourteen years average temperature at the Station	27.4	27.2	35.6	48.6	57.9	68.1	71.2	69.3	63.4	50.5	39.7	31.3	49.1
Mean temperature for the State, 1901	29.2	21.1	39.5	46.7	59.0	70.9	78.1	73.1	64.8	53.8	37.7	27.9	50.2
Fourteen years average temperature for the State	29.1	29.0	37.6	50.5	59.7	70.6	73.7	71.6	65.3	52.7	40.9	32.9	51.2
Rainfall at the Station, 1901	1.58	1.20	3.09	2.46	4.32	4.82	3.32	3.58	5.64	0.81	1.62	3.47	2.99
Fourteen years average rainfall at the Station	3.17	3.00	3.24	2.46	4.20	4.06	4.17	2.97	3.29	2.39	3 37	2.45	3.23
Rainfall for the State, 1901	1.70	1.24	2.66	3.40	3.96	4.38	2.73	3.32	2.86	0.73	1.54	3.79	2.69
Fourteen years average rainfall for the State	2.94	2.87	3.35	2.71	3.71	3.78	3.71	3.34	2.61	2.16	3.33	2.52	3.09

METEOROLOGY—TABLE VI.

SUMMARY BY MONTHS FOR 1901.

	Temperature.											Number of days				Monthly rainfall.	Average daily rainfall.	Monthly snowfall	Prevailing wind.
	Mean.	Highest.	Date.	Lowest.	Date.	Range.	Mean daily range.	Greatest daily range.	Date.	Least daily range.	Date.	Clear.	Fair.	Cloudy.	Rain fell .01 or more.				
At the Station—																			
January	28.3	53	10	—4	2	57	15.7	40	20	5	30	7	3	21	16	1.58	.05	3.50	S. W.
February	20.0	40	16	0	2	40	15.3	30	15	6	20	7	5	16	8	1.20	.04	3.00	S. W.
March	39.1	69	25	—1	6	70	21.5	40	3	7	15	6	4	21	16	3.09	.10	2.50	S. W.
April	45.2	82	30	22	1	62	20.0	43	30	2	*20	12	4	14	15	2.46	.08	20.00	N.
May	57.9	82	2	33	4	49	21.6	42	5	4	27	10	9	12	18	4.32	.14	.....	N.
June	69.1	91	*25	38	*3	53	22.8	38	10	13	15	10	14	6	16	4.82	.16	.....	N. E.
July	75.9	95	*1	50	9	45	22.9	36	20	14	*6	25	6	0	10	3.32	.11	.....	S. W.
August	71.6	94	9	47	5	47	21.8	40	13	9	6	20	4	7	10	3.58	.12	.....	
September	63.3	86	*5	34	19	52	22.2	33	24	10	29	15	6	9	8	5.64	.19	.....	S.
October	51.7	79	23	26	5	53	25.2	39	26	11	*9	23	5	3	5	0.81	.03	T	S.
November	36.6	67	3	15	28	52	16.2	37	4	4	16	11	0	19	11	1.62	.05	2.40	N. W.
December	26.1	64	13	—11	21	75	15.9	41	14	3	26	6	6	19	9	3.47	.11	6.25	S. W.
Sums and averages	**48.7**	**75**	.....	**21**	.....	**55**	**20.1**	**38**	.....	**7**	.....	**152**	**66**	**147**	**142**	**2.99**	**.10**	**19.65**	S. W.
For the State—																			
January	29.2	67	9	—10	3	77	.....	54	20	.....	.....	8	6	17	11	1.70	.05	.....	S. W.
February	21.1	60	17	—20	23	80	.....	47	15	.....	.....	7	8	13	7	1.24	.04	.....	W.
March	39.5	84	25	—8	6	92	.....	51	3	.....	.....	7	8	16	12	2.66	.09	.....	S. W.
April	46.7	91	30	18	1	73	.....	51	30	.....	.....	10	5	15	10	3.40	.11	.....	N. E.
May	59.0	90	24	26	15	64	.....	56	15	.....	.....	10	11	10	13	3.96	.13	.....	N. E.
June	70.9	103	27	30	9	73	.....	52	9	.....	.....	12	13	5	12	4.38	.15	.....	S. W.
July	78.1	109	22	48	9	61	.....	47	21	.....	.....	19	10	2	7	2.73	.09	.....	S. W.
August	73.1	101	*9	42	13	59	.....	50	14	.....	.....	13	12	6	8	3.32	.11	.....	S. W.
September	64.8	98	7	29	19	69	.....	45	22	.....	.....	15	9	6	7	2.86	.10	.....	S. W.
October	53.8	88	29	20	18	68	.....	52	7	.....	.....	18	8	5	4	0.73	.02	.....	S. W.
November	37.7	79	*1	10	*5	69	.....	52	4	.....	.....	9	7	14	7	1.54	.05	.....	N. W.
December	27.9	73	13	—19	21	92	.....	61	14	.....	.....	8	7	16	9	3.79	.12	.....	S. W.
Sums and averages	**50.2**	**87**	.....	**14**	.....	**73**	.....	**52**	.....	.....	.....	**136**	**104**	**125**	**107**	**2.69**	**.09**	.....	S. W.

*On other dates also.

METEOROLOGY—TABLE VII.

SUMMARY BY YEARS AND GRAND SUMMARY FOR FOURTEEN YEARS AT WOOSTER.

	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
At.....	Wooster.	Wooster.	Wooster.	Wooster.	Wooster.	Experiment Station.	Experiment Station.	Experiment Station.
Mean temperature.....	47.3°	48.6°	49.5°	49.6°	48.°	48.7°	50.6°	47.8°
Highest temperature.....	.....	91.5° *1	94.5° Aug. 3	99.0° Aug. 8	98.0° July 25	95.0° *5	98.0° July 19	98.° June 4
Lowest temperature.....	—5° Feb. 9	—5° *2	1.° March 7	0.° March 1	—20.° Jan. 20	—9.° Jan. 11	—7.° Dec. 28	—6.° *8
Range of temperature.....	.....	96.5°	93.5°	99.0°	118.°	104.°	105.°	104.°
Mean daily range of temperature.....	.....	18.7°	18.9°	21.°	19.°	20.2°	22.9°	21.8°
Greatest daily range of temperature.....	.....	42° April 23	41.° Jan. 13	42.° Sept. 23	46.° July 7	45.° Aug. 9	45.° July 31	55.° Oct. 6
Least daily range of temperature.....	.....	2° Jan. 6	4.5° *3	4.° Feb. 8	4.° *4	3.° *6	4.° *7	1.° Nov. 27
Number of clear days.....	.....	125	109	116	116	96	127	125
Number of fair days.....	.....	103	119	110	123	164	154	117
Number of cloudy days.....	.....	137	137	125	98	105	84	123
Number of days rain fell.....	.....	119	149	119	119	129	130	102
Total rainfall.....	38.23 inches	39.87 inches	54.21 inches	38.36 inches	41.46 inches	40.61 inches	30.60 inches	31.45 inches
Greatest monthly rainfall.....	4.54 inches	6.73 in.—July	7.45 in.—Oct.	4.26 in.—June	7.89 in.—June	6.33 in.—Feb.	4.41 in.—May	4.21 in.—Nov.
Least monthly rainfall.....	1.39 inches	1.36 in.—Oct.	1.74 in.—Dec.	1.95 in.—April	1.37 in.—Oct.	1.38 in.—July	0.76 in.—Aug.	1.00 in.—Feb.
Prevailing direction of wind.....	S.....	S.....	S.....	S.....	S. W.....	S. W.....	S. W.....	N.....

*1 July 10, Sept. 1. *2 Feb. 23 and 24. *3 Jan. 8 and Sept. 10. *4 March 5, Nov. 1, 3, 25, Dec. 1 and 18. *5 July 7, 25 and Sept. 7. *6 Jan. 24, Feb. 11, and May 26. *7 Dec. 1 and 23, *8 Jan. 12, 13 and Feb. 5.

METEOROLOGY—TABLE VII—Concluded.

SUMMARY BY YEARS AND GRAND SUMMARY FOR FOURTEEN YEARS AT WOOSTER.

At.....	1896 Experiment Station.	1897 Experiment Station.	1898 Experiment Station.	1899 Experiment Station.	1900 Experiment Station.	1901 Experiment Station.	Summary for fourteen years.
Mean temperature	49.6°	49.4°	50.4°	49.5°	50.7°	48.7°	49.2°
Highest temperature	93.° Aug. 9	96.° *10	96.° July 3	95.° Aug. 20	95.° July 4	95.° July *12	99.° Aug. 8, 1891
Lowest temperature	—6.° Feb. 19	—18.° Jan. 26	—9.° Feb. 2	—21.° Feb. 10	—10.° Feb. 27	—11.° Dec. 21	21.° Feb. 10, 1899
Range of temperature	99.°	114.°	105.°	116.°	105.°	106.°	120.°
Mean daily range of temperature	19.°	21.5°	20.3°	22.9°	20.6°	20.1°	20.5°
Greatest daily range of temperature	43.° May 8	49.° Oct. 5	50.° Nov. 14	52.° Oct. 24	43.° May 6	43.° April 30	55.° Oct. 6, 1895
Least daily range of temperature	3.° *9	0.° Feb. 6	5.° *11	3.° Feb. 18	2.° Nov. 20	2.° April 20	0.° Feb. 6, 1897
Number of clear days	130	124	133	126	149	152	125
Number of fair days	106	123	104	114	98	66	115
Number of cloudy days	130	115	128	125	118	147	121
Number of days rain fell	134	128	134	116	132	142	127
Total rainfall	38.47 inches.	36.16 inches.	47.85 inches.	32.93 inches.	36.61 inches.	35.91 inches.	38.77 inches.
Greatest monthly rainfall	8.05 in. July.	5.76 in. Nov.	6.79 in. July.	5.56 in. Nov.	5.97 in. Aug.	5.64 in. Sept.	8.05 in. July, 1896
Least monthly rainfall	0.71 in. Oct.	0.29 in. Sept.	2.15 in. Sept.	0.53 in. Aug.	0.99 in. Dec.	0.81 in. Oct.	0.29 in. Sept. 1897
Prevailing direction of wind	S. W.	N. W.	N., S. W.	S.	S. W.	S. W.	S. W.

*9 Jan. 10 and March 8. *10 July 5 and 6. *11 Jan. 21, March 2 and Dec. 18. *12 July 1, 22, 28 and 29.

METEOROLOGY—TABLE VIII.

SUMMARY BY YEARS AND GRAND SUMMARY FOR NINETEEN YEARS FOR THE STATE.

For the State.	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892
Mean temperature	49 4°	50.6°	48.0°	49.6°	51.4°	49.5°	51.1°	52.4°	52.0°	50.0°
Highest temperature	98.° Aug. 22	98.° *1	101.° July 21	98.6° July 7	108.° July 18	102.° Aug. 3	99.5° Aug. 31	103.1° Aug. 3	101.° Aug. 10	103.° July 25
Lowest temperature	-17.2° Jan. 22	-34.° Jan. 25	-31.° Jan. 29	-21.5° Jan. 12	-21.° Jan. 7	-15.° Jan. 27	-13.5° Feb. 24	-4.° Mar. 7	-5.° Mar. 8	-25.° Jan. 20
Range of temperature	115.5°	133.°	132.°	120.1°	129.°	117.°	113.°	107.1°	106.°	128.°
Greatest daily range temp'tre	55.2° Mar. 18	50.° *2	58.5° Jan. 30	57.° Dec. 11	57.° Apr. 11	50.°	53.° Mar. 30	49.5° Apr. 11	50.° *3	51.° Sept. 25
Average numb'r days rain fell	146	145	148	131	121	125	118	149	120	121
Mean yearly rainfall	44.98 inches	40.19 inches	38.08 inches	36.71 inches	33.63 inches	39.64 inches	33 53 inches	50.33 inches	38.61 inches	37.16 inches
Mean daily rainfall	.123 inch	.110 inch	.104 inch	.100 inch	.049 inch	.108 inch	.092 inch	.138 inch	.110 inch	.100 inch
Prevailing wind	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.

	1893	1894	1895	1896	1897	1898	1899	1900	1901	Summary for nineteen years.
Mean temperature	50.1°	52.4°	49.9°	51.8°	50.6°	52.°	51.5°	52.2°	50.2°	50.8°
Highest temperature	102.° July 19	105.° *4	106.° July 20	103.° Apr. 17	113.° July 4	105.° July 1	105.° Sept. 6	103.° *8	109.° July 22	113.° July 4,'97
Lowest temperature	-24.°	-27.° Dec. 29	-24.° Feb. 6	-18.° *6	-27.° Jan. 26	-20.° Feb. 3	-39.° Feb. 10	-20.° *9	-20.° Feb. 23	-39.° Feb. 10 1899.
Range of temperature	126.°	132.°	130.°	121.°	140.°	125.°	144.°	123.°	129.°	124.8°
Greatest daily range temp'tre	54.6°	60.° Oct. 19	59.° *5	53.° Mar. 25	67.° *7	.....	.....	57.° Feb. 9	61.° Dec. 14	67.° Sept. 28 1897.
Average numb'r days rain fell	113	100	89	124	110	121	107	107	107	121
Mean yearly rainfall	39.63 inches	29.75 inches	28.46 inches	39.58 inches	38.54 inches	43.78 inches	34.51 inches	32.87 inches	32.98 inches	37.52 inches
Mean daily rainfall	.110 inch	.080 inch	.070 inch	.120 inch	.100 inch	.119 inch	.094 inch	.091 inch	.091 inch	.101 inch
Prevailing wind	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.

*1 Sept. 28th and Oct. 1st. *2 Sept. 5th and Dec. 4th. *3 April 27th and 30th. *4 July 18th and 19th. *5 Jan. 15th and March 29th. *6 Feb. 9th, 10th and 11th. *7 Sept. 25th and 26th. *8 July 4th, Aug. 6th, and 10th. *9 Jan. 29th and Feb. 27th.

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PRESS BULLETINS.

The following press bulletins have been issued during the year:

No. 225, July 29, 1901. FIGHTING THE CHINCH BUG. (By Chas. E. Thorne.)

The Ohio Experiment Station is receiving letters indicating an extensive outbreak of chinch bugs in certain parts of the State, and in response it is sending out small packages of a fungus culture in the hope that it may be of service in infecting the bugs with a parasitic disease which, under favorable conditions, has been found to be very destructive to these pests.

This fungus, however, requires moist weather and masses of insects for successful operation, and it may not act with sufficient promptness during dry weather. The following remedy is therefore offered as probably better adapted to existing conditions, this remedy having been suggested in 1895 by Prof. S. A. Forbes, State Entomologist of Illinois:

"Dissolve one-half pound hard or soft soap in one gallon of water, and heat to the boiling point. Remove from stove and add two gallons of coal oil, churning the mixture with a good force pump for fifteen minutes. When the emulsion is formed it will look like buttermilk.

"To each quart of this emulsion add fifteen quarts of water, and apply to the corn in a spray—preferably before 10 A. M. or after 3 P. M. The bugs should be washed off so that they will float in the emulsion at the base of the plant. A teacupful to a hill is generally sufficient, but the quantity must vary with the number of bugs infesting the corn."

The progress of these bugs through a field may be obstructed by making a shallow, V-shaped trench with the corner of a hoe and filling it with coal tar, the tar to be renewed in two or three days. They may also be destroyed by plowing them under and harrowing and rolling. These two methods were successfully employed by the Ohio Station in 1888.

No. 226, August 5, 1901. SOIL ANALYSIS AS A GUIDE TO THE USE OF FERTILIZERS. (By Chas. E. Thorne.)

The Ohio Experiment Station receives many such requests as the following: "Will you make a chemical analysis of my soil to determine whether I need nitrogen, potash or phosphoric acid, and if so, what will be the charge?"

To this request we make the uniform answer that such an analysis would be very expensive and when made would usually have very little value as a guide to the use of fertilizers, for the reason that the chemist has as yet discovered no reagent which possesses the same capacity for extracting plant food from the soil as that of the living tissues of the plant.

To illustrate: Potash is a characteristic constituent of granite rocks, and a soil formed from such rocks may appear rich in potash under the chemist's analysis, and yet if that potash be still in the form of granite sand it will be yielded up very slowly to the feeble solvents of the plant.

Again: In some of the southern states are immense beds of rock containing large percentages of phosphoric acid; but if these rocks are merely ground and mixed with the soil their phosphoric acid, which has resisted the solvent action of soil water for ages, will continue insoluble, and hence the necessity for treating these ground rocks with sulphuric acid, in order to make their phosphoric acid available.

Still further: When a piece of marshy land has been drained it is often found that the crops planted upon it fail to thrive, although it seems to be very rich in nitrogen. The remedy here is to add barnyard manure, something which savors strongly of carrying coals to Newcastle; but the explanation is that the semi-aquatic vegetation which formerly occupied the land decays so slowly that cultivated crops cannot get nitrogen rapidly enough for their needs. When manure is added, however, it sets up a fermentation which converts the nitrogen bearing materials into a more soluble, and hence available form.

For these reasons, the only practical way of learning the needs of a particular soil is to make experiments on that soil, after the general plan of those described in the bulletins of the Experiment Station on the maintenance of fertility, and thus learn which combination of fertilizing materials will produce the greatest effect.

No. 227, September 1, 1901. THE HESSIAN FLY. HOW LATE MUST WHEAT BE SOWN TO ESCAPE IT'S RAVAGES? (By Chas. E. Thorne.)

In the fall of 1900 the Ohio Experiment Station made weekly sowings of wheat from August 31 to October 26 at the Central Station at Wooster, and from September 1 to October 13 at the substation at Strongsville, 40 miles north. Other sowings were made at both places from September 18 to October 1. In both tests the first sowing was practically untouched by the fly. At Wooster, the wheat sown September 7 and 14 was more than half destroyed by the fly. That sown September 28 made about three-fourths of a crop, and that sown after October 1 escaped injury. At Strongsville the injury culminated in the sowings of September 15 and 18, the wheat sown on the later date being almost completely destroyed. On wheat sown after September 25 there was but little injury.

At Columbus, wheat sown October 4 and 5 suffered but little. In the southern part of the State wheat sown before October 10 was considerably injured, while that sown after that date measurably escaped.

It will be observed that the dates of safety from fly indicated by these experiments are generally later than it has heretofore been supposed to be necessary to wait to avoid the fly; but in 1877, Prof. A. J. Cook, writing of the disastrous attack of the fly in that state, stated that destructive attack was repeatedly observed on wheat sown as late as September 20, and Director C. D. Smith, of the Michigan Experiment Station, has reported severe injury to wheat sown there on the 20th of last September.

It seems, therefore, that the date of actual safety, in seasons of general prevalence of this pest, is so late as to incur as great a risk from winter-killing as the ordinary risk from the fly. The farmer who will observe closely, however,

has it in his power to reduce his risk somewhat by the following method: Sow a part of the crop at a medium early date, say September 5 to 7 for northern Ohio to September 15 to 18 for the southern part of the State; and then in about three weeks examine the wheat plants very carefully at the point where the well known "flax seeds" of the fly are found. It will be too early as yet to find the "flax seeds," but if the fly has commenced its work the very small, white maggots which later develop into the "flax seeds" should be found sucking the juice from the plant. These maggots are at first so small that it will require close searching to discover them, and a magnifying glass of low power will be a help, though not absolutely necessary.

If the maggots are found it will be wise to delay seeding a few days longer; but if none are found the whole crop may be sown with good assurance of escape.

The advantages of this method are not only that it will enable us to discover whether the fly is present in injurious numbers at an earlier date, but that if the fly be present it will probably be attracted to the early sown wheat and induced to deposit all its eggs, thus effectually protecting the wheat sown later. To accomplish this object a considerable area must be sown, for we have had no evidence that the tenth-acre plots used in our experiments in early and late seeding have exerted any protective influence on the remainder of the field in which they were located. On the other hand, we have found the general attack upon our field work to be made at about the dates when the weekly sowings were most severely attacked. *

Numerous instances have been reported in which wheat sown one day has been attacked by fly while that sown the day following has escaped. These can only be satisfactorily explained on the assumption that the earlier sown wheat attracted the fly and proved sufficient in area to occupy all the flies in the immediate neighborhood.

In case of an injurious attack developing upon the early sown wheat it should be turned under, in order to destroy the insects and prevent a further attack the following spring. The cost of turning under and reseeding would usually be small in comparison to the loss which would result from the fall attack and from carrying over a host of flies to prey upon the crop during the spring.

No. 228, September 9, 1901. LIME AS A FERTILIZER. (By Chas. E. Thorne.)

A renewed interest in the use of lime on the soil has been excited by the experiments of the Rhode Island Experiment Station, at Kingston, in which a large increase of certain crops was produced by liming the soil. While the Ohio Experiment Station was located on a gravelly, clay loam at Columbus experiments in liming were made, but with negative results. This work has recently been undertaken again, however, on the lighter, more sandy clay of the soil on which the Station is now located, and although it has not yet gone far enough to justify positive statements, the present indications are such as to encourage a more extended trial.

In one case a half acre of land on which wheat is being grown year after year was treated with a thousand pounds of lime, freshly slaked and applied broadcast just before sowing the wheat. The crop immediately following showed but little effect from the lime; but the second crop, just harvested, shows an increase of about six bushels per acre for the limed portion over the unlimed half acre adjoining.

* A better method than this will be given in a future bulletin. C. E. T.

In another case, half of a tract of three acres was limed in the spring of 1900 and planted in corn. There was an apparent increase in the corn crop for the limed part of this tract over that left without lime, and in the oats crop, following the corn, there has been a further increase of over nine bushels per acre.

In a third case, part of a block of alfalfa was sown on limed soil, and part on unlimed, with the result that the limed portion made by far the more vigorous growth.

One method of applying lime is to pile unslaked lime in small piles on land which has been plowed and harrowed, slack by wetting and covering with earth, then mix thoroughly with loose earth and spread with the shovel. Piles of a peck each, a rod apart, will give forty bushels, or 2,800 pounds per acre, which would be considered a moderate dressing.

Slacked lime cannot be easily applied with the ordinary fertilizer drill, but unslaked lime, ground to coarse meal, is now on the market, and this may be successfully applied in this manner.

The function of lime is not, properly speaking, that of a fertilizer, as its effect is not so much due to the actual plant food which it carries to the soil as to the rendering available of plant food already in the soil, and of improving the physical condition of the soil itself; hence the lime should be as fresh as possible.

In consequence of this effect of lime it should always be followed by liberal manuring or fertilizing, otherwise its use will tend to exhaust the soil; but lime should never be mixed with manure, nor with other fertilizers, especially those containing ammonia, as it will liberate the latter and cause its escape. It should be applied as long as possible before the crop is planted, and is likely to be especially beneficial to clover, timothy, and other grasses.

No. 229, September 16, 1901. How Much Seed Wheat to the Acre? (By Chas. E. Thorne.)

In the fall of 1877 an experiment was begun on the farm of the Ohio State University in seeding wheat at different rates per acre. The experiment was made on rich bottom land, and although a yield of 34 bushels of wheat was harvested from five pecks of seed the yield for seven pecks was 37 bushels. The next year the experiment was repeated with great care, five duplicate plots of one-sixth acre each being sown with each quantity of seed, with the result again that the seven peck rate of seeding gave enough more wheat than any smaller quantity to abundantly compensate the extra cost of seed.

In 1882 this question was taken up by the Ohio Experiment Station, then located on the same farm, and was repeated nearly every year until the Station was removed to its present location. The final summing up of these experiments, made in 1891, indicated a maximum average yield on that soil for quantities of seed ranging from five to seven pecks.

In 1892 the Station was removed to its present location, the soil of which is naturally far less productive than that upon which it was first located, and after a few years the investigation of this problem was again undertaken, with the result that the most profitable harvests have been reaped from eight pecks of seed and upward, the nine and ten peck rates having given the best returns in unfavorable seasons.

No. 230, September 23, 1901. CAN WE AFFORD TO OMIT NITROGEN AND POTASH FROM OUR FERTILIZERS? (By Chas. E. Thorne.)

One of the fertilizer experiments of the Ohio Experiment Station is located on a tract of thin, clay land, which had been reduced to a very low state of fertility by exhaustive cropping. In this experiment corn, oats and wheat are grown in rotation, followed by two years of clover and timothy, making a total rotation of five years. Five sections of 30 plots each are used in the test, so that each crop is harvested each season. Eight crops each of corn, oats and wheat have been grown in the test thus far, with seven crops of clover and six of timothy.

Plot No. 2 in this test receives no fertilizer except acid phosphate, which is applied to corn and oats at the rate of 80 pounds per acre, and to wheat at the rate of 160 pounds, making a total of 320 pounds applied in five years.

Plot 8 receives the same quantity of acid phosphate, together with 260 pounds of muriate of potash, distributed over the three cereal crops.

Plot 11 receives the same quantities of acid phosphate and muriate of potash as Plot 8, with the addition of 480 pounds of nitrate of soda, distributed likewise over the cereal crops.

At the average market prices for fertilizing materials and farm produce the cost of the fertilizers and the value of the increase of crop from these dressings has been as follows:

Plot.	Cost of fertilizer.	Value of increase.	Profit.
2	$2.40	$9.66	$7.26
8	8.90	16.44	7.54
11	20.90	26.61	5.71

Taken as they stand, these figures indicate that it has not been profitable to add nitrogen to the fertilizers; but other experiments made at the Station show that the cost of the nitrogen might be materially reduced by substituting tankage for nitrate of soda, and they also indicate that the quantity of both nitrate of soda and muriate of potash used in these tests has been larger than was required to produce the most economical result. This is illustrated by Plot 30, which for six years received a mixture of tankage and acid phosphate, carrying the same quantity of phosphoric acid as that given to Plots 2, 8 and 11, and much smaller quantities of nitrogen and potash. The increase from this plot has been practically equal to that from Plot 8, while the cost of the fertilizers has been but $3.75, thus showing a very much larger net profit than that given by acid phosphate alone.

The lesson taught by these experiments is that clover alone will not furnish sufficient nitrogen for maximum crop yields in long rotations like this, and that, while it is not profitable to add as much nitrogen and potash as would be indicated by the composition of the crops, yet we cannot afford to dispense with them altogether.

No. 231, September 30, 1901. THE HESSIAN FLY AT WORK. (By Chas. E. Thorne.)

On September 25 the Hessian fly was found busy at work laying its eggs on the experimental sowings made at the Ohio Experiment Station Sept. 1, 7 and 14. On the latest sown wheat, the plants of which consisted of a single spear, three to four inches high, practically every plant carried from one to a

dozen eggs. On the earlier sowings the eggs were not quite so abundant, especially on that of Sept. 1.

It is extremely desirable that more thorough observations be made upon this insect than have ever yet been reported, especially with regard to its appearance and disappearance in various localities, and the Experiment Station urges that such observations be at once undertaken throughout all that portion of the State where the fly may not yet have finished its work.

The Hessian Fly is a minute insect, somewhat resembling the mosquito, but considerably smaller. The abdomen of the female is extended into a long, slender ovipositor, and when engaged in egg laying she flies from the ground to the plant, deposits one or more eggs, an operation requiring but a fraction of a minute, then to the ground and soon to another plant. The eggs, which are only barely visible to the unaided eye, are reddish in color, several times as long as wide, and are deposited end to end in the minute creases of the yonng wheat blade, usually on the upper or inward side. They are said to hatch in four to ten days, owing to the temperature, but further observation is needed on this point. They are so small that a glass magnifying 3 to 5 diameters is necessary to a satisfactory examination. A suitable pocket lens in a rubber case can be procured of any optician for 50 to 75 cents.

It would seem probable that a sharp frost, occurring while the eggs are exposed, would prevent their hatching, but no observation seems ever to have been made on this point.

Care must be taken not to confuse the Hessian fly with a gnat-like plant louse, which is often found fixed on the wheat blade with its sharp proboscis inserted into the blade, from which it is sucking the sap. These are not usually sufficiently numerous to cause any material injury, but some of them are about the size of the fly. Their rounded abdomen and sluggish action serve to distinguish them readily from the slender, active flies.

In neighborhoods where occasional fields of wheat have been sown the flies will probably have expended all their egg laying energies upon these and it will now be safe to sow the general crop; but where everybody has delayed sowing the risk may be greater, for we do not know how long the fly is able to hold her eggs, waiting for the farmer to provide a suitable place for them.

Where wheat is as badly infested as are the experimental sowings at this Station it would be wise to plow under and sow again; for such wheat will not only be almost destroyed, but it will serve to carry over a host of the well known "flax seeds" of the fly, from which a new brood will emerge next spring to continue the destructive work.

The Experiment Station urges that careful observations be made all over the State on the points above indicated, and the results reported to it at Wooster.

To-day, Sept. 27, eggs are being laid on wheat sown Sept. 21.

No. 232, March 17, 1902. OAT SMUT—HOW TO PREVENT IT. (By A. D. Selby.)

Farmers who grow oats know how much grain is at times destroyed by smut; the amount of smut ranges from almost nothing to one-third, or in extreme cases even one-half, the entire yield. On an average it is computed that this loss is not less than 6 per cent. of the annual Ohio oat crop, or $450,000 to $500,000 each year. This loss is practically all preventable by a simple method of treating

the seed oats to kill the smut spores, which are sown with the seed only, and the Experiment Station has proved this method to its entire satisfaction. This is known as the formalin method of Bolley. Formalin is a clear liquid, a solution of formaldehyde in water, and may be purchased at drug stores for about 50 cents per pound. Each pound is sufficient to stir into 50 gallons of water and will treat 50 bushels of seed oats; 1 ounce is enough for 3 gallons of water and will treat 3 bushels of oats. The amount purchased will be determined by the number of bushels of oats to be treated. Formalin is not poisonous, though not wholesome; it is well to avoid smelling of the strong solution as purchased, because it is irritating to the nostrils. The very dilute solution used for oat smut is not objectionable.

TO TREAT SEED OATS FOR SMUT.

Having the solution made at the rate of 1 ounce of formalin to three gallons of water, well stirred, and a gallon of solution to each bushel of seed to be treated, apply this with a sprinkling can to the oats in piles on a tight floor. Grain piles should not exceed about 6 bushels and the number of piles will follow from the amount of seed. Sprinkle each pile in turn, shoveling thoroughly, knowing how much solution is applied; continue in each case until the solution tends to run out on the floor despite the shoveling. Usually a half gallon or more per bushel may be sprinkled on the first round, when the one pile is passed for a few minutes while another is handled in the same way. Upon a second sprinkling of each pile as much solution is used as will be held; then with a third or fourth repetition the gallon per bushel may be used. After this shovel over and leave in low flat piles over night, or for not less than 4 hours. The seed may then be spread thin on a floor and shoveled over occasionally to dry out for drilling, or it may be sown wet if broadcasted. If in weather when proper drying of the seed is secured, the treatment of the seed may precede the time of sowing by some weeks. Seed treated in this manner is not poisonous, though scarcely suitable to be fed to horses.

TO PROCURE FORMALIN.

The Experiment Station has no pecuniary interest in commercial transaction but an easy and reasonable acquisition of the formalin may advance the Station's teachings. Learning that some have been unable to purchase formalin near at home the Station has arranged to have local drug firms fill orders at the following rates, if orders are sent to the Experiment Station. It is preferred that the purchases be made at home. One oz. bottle of formalin by mail, 15 cents; 2 oz. bottle by mail, 25 cents; 4 oz. bottle by mail, 30 cents, postage in all cases prepaid. By express ½ pound formalin, 35 cents; 1 pound, or pint, formalin 40 cents, expressage paid by recipient. Remittances should be made to the Station.

The Station Botanist is also Director of this line of experiments in the Agricultural Student Union of Ohio, and will be able to supply formalin upon agreements to conduct experiments and report results, to one or more persons in each township of the State. Applications in this line for experiments may be addressed to the Station Botanist. Other requests, remittances or inquiries should be addressed to the Experiment Station, Wooster, Ohio.

No. 233, March 24, 1902. SWEET CLOVER AS A SOIL AMELIORANT. (By Chas. E. Thorne.)

Those who have carefully observed the habits of the wild sweet clover (otherwise known as Bokhara clover or melilot) have noticed that its volunteer growth is practically confined to road-sides where the surface soil has been scraped away or where the ground has been puddled by trampling, and to similar locations elsewhere, such as the bottoms of abandoned brickyards or places in pasture fields where the soil has been trampled while wet, or hillsides from which the surface soil has been washed away. It is practically never found invading pastures or other lands which have been kept in good condition.

At the Ohio Experiment Station the seeds of this plant have repeatedly been sown on soils which were merely thin, but not washed or puddled, but invariably without success. The only case in which it was induced to grow was where it was sown on the bottom of an old brickyard at Columbus in 1888. Here a full stand and vigorous growth were obtained, and the crop was allowed to stand and re-seed itself until the fall of 1891, when it was plowed under and the land sown to wheat. The result was a yield of 26.9 bushels of wheat per acre on the land where melilot had grown, against a yield of 18.6 bushels on similar land alongside, which had been cropped with corn and oats the two seasons previously.

The Experiment Station Record reports an experiment made near Tost, Germany, in which melilotus was sown with rye in the spring of 1889 and was plowed under the following spring and the land sown to oats followed by potatoes. The result was an increase of 17 bushels per acre in the oats crop and a doubling of the potato crop.

Animals do not eat sweet clover readily, but when confined to it they are said soon to learn to relish it, and it is largely grown for forage and hay in the southern states. It resembles alfalfa in appearance and habits of growth, and like alfalfa must be cut before full blossoming if it is desired to make hay of it, otherwise the stems become too hard and woody. Like alfalfa it will furnish two or three crops of hay in a season; but it differs from alfalfa in being a biennial plant, so that it will disappear at the end of the second season after seeding unless permitted to re-seed itself.

As a plant for green manuring Prof. S. M. Tracy, formerly of the Mississippi Experiment Station, says of it in Farmers Bulletin 18 of the U. S. Department of Agriculture: "As a restorative crop for yellow loam and white lime lands this plant has no superior, and for black prairie soils it has no equal. The roots are very long, penetrating the soil to a depth of 3 or 4 feet; are quite large, and by their decay at the end of the second year leave the soil with innumerable minute holes which act as drains and loosen the soil, so that the roots of other crops can go deeper and find more abundant supplies of food and bear drouth better."

The appearance of sweet clover is a signal that the soil is out of condition. Its mission seems to be to occupy the waste places and neglected spots of the earth and to prepare them for the growth of other plants.

No. 234, March 31, 1902. SPRAYING FOR THE SAN JOSÉ SCALE LOUSE. (By W. J. Green.)

Various mixtures have been proposed for this insect and a number have been found to be more or less effective. It is hardly possible, however, to apply any remedy with such thoroughness as to reach every scale, and because its natural enemies are few and its rate of reproduction very rapid, complete eradication is practically impossible; but by treatment each season it is entirely practicable to hold it in check. The choice of a compound with which to make treatment is not to be determined alone by its efficiency, but by its availability and practicability as well. Resin washes, composed of resin, potash and fish oil, have been found to be efficient, but are troublesome to prepare in a small way. The same is true of a whitewash made of lime, sulfur and salt. Whale oil soap, when used as strong as two pounds to a gallon of water, and applied with thoroughness, is a good remedy. Its cost precludes its use in many cases and the difficulty of finding suitable weather conditions for the application of it make results with it quite variable. While not without objections, crude petroleum has been found, in most cases, to meet the requirements better than any other remedy yet tried at the Ohio Experiment Station. The thin, light grade is safer and less troublesome to use than the thick, heavy grade, although when diluted with water the latter is less objectionable than if used clear. Refined oil is more harmful than crude.

Good results have been secured in spraying scale infested trees with 25 per cent of crude petroleum and water, also with higher percentages of oil. Trees have been injured, and even killed, with 25 per cent of oil. On the other hand many thousands of trees, in all parts of the country, have been sprayed with clear crude petroleum, and with various percentages, without injury.

The manner of spraying has much to do with the effect upon the trees. When the material is applied in such quantities as to run down the limbs and bodies of the trees, injury is almost sure to occur, even if the oil is diluted with water. Sometimes the operator, trusting to dilution to prevent damage, sprays excessively, or until the mixture runs down to the roots. The oil is thus unevenly distributed and unknown quantities reach certain parts of the tree, resulting in local injury.

Peach trees are very tender and should be sprayed with more than ordinary care. If whale oil soap is used the work should be done just as the buds are swelling.

The only safe way is to stop spraying before the mixture begins to run, and this rule applies to diluted as well as to clear crude petroleum. With a suitable pump, like the Spraymotor, 25 to 50 percent crude petroleum can be used safely and economically, but if the pump cannot be relied upon to give accurate per centages then clear crude petroleum can be applied with any pump. A nozzle which will give a fine spray is needed in all cases, and for this purpose the Vermorel is satisfactory. Choose a day for spraying with crude petroleum when evaporation is rapid, as greater injury is done in damp than in drying weather. If the sun shines and the wind is blowing, all the better. A light wind is not advantageous but a brisk or high wind assists operations materially. When there is no wind begin at the top of the tree, spraying around the tree, and

work downward, rather than upward. Avoid double applications, such as may result by spraying up and down the tree. If the wind is brisk hold the nozzle high and let the material drift through the trees. In this way trees some distance away may be covered almost as well as those near by. The operator must shift his position and change the height of the nozzle as experience shows to be necessary. When the wind changes, another application must be made on the other side of the tree. There is less danger of overspraying in a high wind than when the air is calm, but there is also a greater probability of missing parts of trees. In early spring, just before the buds open, is the best time to spray, although no harm may be done if the work is performed earlier. The work can be done much better if the trees are first severely pruned by cutting off the ends of the branches. In case trees are seriously infested this operation is necessary in order to secure good results, after removing one-third or one-half of the top. Peach trees will endure very close pruning and no harm will be done if the top is all cut away and a new one started. Close pruning also assists the trees to recover from the weakening effects of the scale.

It is seldom advisable to destroy trees because of infestation, but it is usually better to prune and treat than to dig out, because new trees put in place of the old ones would soon become infested.

No. 235, April 14, 1902. BITTER-ROT OF APPLES. (By A. D. Selby.)

The Ohio Experiment Station has received, during past seasons, reports of heavy losses of apples from the bitter-rot. These reports indicate rather greater frequency of bitter-rot on sweet varieties, although the disease spreads to other sorts. The losses are reported more frequently from southern Ohio, but the Station is not sufficiently informed as to the extent or the local distribution of the bitter-rot.

The disease attacks the fruit before ripening in midsummer and often practically destroys all the fruit before picking time. Much of that which is not totally destroyed is spotted by the disease and is lost in storage. The rotted spots are dark and impart a bitter taste to the fruit. Every apple grower will doubtless recognize the disease by name without any detailed description.

The Ohio Experiment Station has asked the Legislature of the State to provide the necessary funds to enable it to conduct experiments and to advise apple growers as to remedies for this bitter-rot of apples.

WHO HAS SUFFERED FROM BITTER-ROT?

In order to be ready for this work if the appropriations are made for it, more information is needed, including if possible the addresses of all who have suffered losses from bitter-rot of the apple and who may desire to learn of a remedy for the disease. This is especially desired from southeastern Ohio, including the names of varieties which rot worst.

All who have suffered such losses, or who desire advice and assistance in fighting bitter-rot, are requested to respond by writing a postal card, or letter, to the Botanical Department of the Station. Early and full responses are solicited. Address, Ohio Experiment Station, Wooster, O.

No. 236, April 21, 1902. GRAPE ROT AND ITS PREVENTION. (By A. D. Selby.)

Grape rot has been serious in many Ohio vineyards during recent years; this has been especially true since 1898 or 1899. The actual dates for the beginning of the destructive prevalence of grape rot are not accurately known to the Experiment Station. Upon this point grape growers will confer a great favor by advising the Station.

THE PREVENTION OF GRAPE ROT.

The experiments conducted by the Station Botanist and his assistant have proved that thorough and repeated sprayings for rot with the recommended fungicides is an effective and profitable remedy. The number of treatments made in 1901 was seven, beginning when the shoots were one to two feet long. The cost of this treatment was about $7.00 per acre; the gross receipts per acre from sprayed grapes was $125.20 per acre, and from unsprayed grapes less than $10.00 per acre in the same vineyard. A full description of the experiments is published in Bulletin 130, which will be sent free on request.

BORDEAUX MIXTURE, SODA BORDEUAX MIXTURE AND EAU CELESTE.

Plant pathologists are quite well agreed that Bordeaux mixture is the most effective fungicide for ordinary plant diseases. It is made from copper sulfate and lime. But Bordeaux mixture may not be used upon fruit as ripening approaches because it adheres to the fruit. For later sprayings on grapes, that is after July 10 to 15 on Concords or other early varieties, Soda Bordeaux mixture appears to be a very effective fungicide and is cheaper than the ammoniacal copper carbonate heretofore recommended. This spray is made from caustic soda and copper sulfate. Full directions for making Soda Bordeaux mixture are given in Bulletin No. 130. Full directions for spraying apples and grapes are contained in a special calendar prepared for that purpose. Both will be sent upon application,

Grape growers are warned against the use of Eau Celeste in spraying grapes or other fruits. This fungicide, which is made by using ammonia and copper sulfate, injures the foliage and the fruit will not ripen properly on vines so treated.

FIELD WORK ON GRAPE ROT BY THE EXPERIMENT STATION.

The Ohio Experiment Station, by its department of plant pathology, has prepared to keep a specialist in the field during the season of 1902 to advise and direct vineyardists in the proper preparation of the spray mixtures and in the prevention of grape rot, and to conduct illustrative experiments in certain localities. To be able to plan this work and to be of most service in it, more information is wanted.

ADDRESSES OF GROWERS NEEDED.

To give this knowledge grape growers who have suffered losses from rot and who wish advice and direction in the work of spraying are requested to write at once to the Station Botanist, stating these facts together with the vineyard area, and the varieties that have been lost by rot. After this information is at hand and the season arrives, routes may be arranged and notice given with dates of appointments.

PREPARATIONS FOR WORK SHOULD BE MADE.

It is the desire of the Experiment Station to help all vineyardists in fighting the grape rot, by advice and direction, but the actual spraying work will fall to them and will not be undertaken by the Station. Vineyardists are advised to prepare by providing good traction or other spray pumps with one or two lines of hose attached, carrying nozzles at the ends of the hose. It has been found necessary to direct the spray by holding the nozzles; traction sprayers that are not so arranged must be changed to permit this, if successful spraying for grape rot is to be secured.

No. 237, April 28, 1902. SPECIAL SPRAYING INSTRUCTIONS. (By A. D. Selby.)

To meet immediate needs the Ohio Experiment Station has prepared the following brief directions concerning apples and grapes;

SAN JOSÉ SCALE LOUSE.

For San José Scale on apple and grape (including peach and cherry) crude petroleum, undiluted, is recommended as safe and efficient when applied according to No. 17 below; peach and plum are more tender and must be sprayed with caution. Crude petroleum may be applied at any time during the winter, preferably near spring; lime, salt and sulfur mixture may also be used and very much later, even after the leaves have appeared.

CODLIN MOTH AND CANKER WORM.

These are both covered by Calendar directions; codlin moth also by bitter-rot treatment with arsenites added. For canker worm, *treatment early while worms are very small* is essential.

APPLE BITTER-ROT.

Spraying for this, to be successful, begins *as buds are opening* followed by a second and third spraying as for scab; About 10 days later a fourth spraying is made strictly for bitter-rot, followed by a fifth and sixth in all. *After the third, Soda Bordeaux mixture* should be used on all sprayings and in it the *arsenites may be added* for codlin moth.

If dust spraying is practiced instead of ordinary liquid applications, *about double the number of applications* will probably be required and must be made when the foliage is moist, say from 4 to 8 A. M., or following a fog.

Careful and thorough work will be required in orchards where the bitter-rot has prevailed unchecked in the past.

GRAPE ROT.

The first spraying for grape rot is made upon the new shoots when 1 to 2 feet long, that is, just before blooming. The Bordeaux mixture may be used for four sprayings on ordinary sorts or for a fifth on Catawbas, to be followed in all cases with three sprayings of Soda Bordeaux mixture. The intervals should be shortened *if threatening weather prevails at the dangerous period of rot prevalence.*

For directions as to making Soda Bordeaux mixture and for testing Caustic Soda and having Station test the same, see Bulletin 130. Apply for this Bulletin if not at hand.

DIRECTIONS FOR MAKING SPRAY MIXTURES.

FUNGICIDES.

1. Bordeaux Mixture I.

Copper sulfate (blue vitrol) 4 pounds.
Quicklime (not air slaked) 4 pounds.
Water, to make 50 gallons.

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring, or even better, by suspending the sulfate, contained in a cheese cloth sack, in a large bucketful of cold water. With the cold water and cheese cloth bag, a longer time is required. Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water. Slake the lime by addition of a small quantity of water, and when slaked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but stone lumps or sand is taken up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough agitation the mixture is ready to apply. The mixture must be made fresh before using, and any left over for a time should be thrown out or fresh lime added.

2. Bordeaux Mixture II.

This is half the strength of Bordeaux I. To use on peach and cherry foliage.

3. Ammoniacal Solution of Copper Carbonate.

Copper carbonate, 6 ounces.
Ammonia, about 3 pints.
Water, 50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

Caution:—Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

4. Soda Bordeaux Mixture.

Copper sulfate, 4 pounds.
Commercial Caustic Soda, Soda lye, (Sodium hydroxid) slightly in excess so that mixture is alkaline—according to strength, 1 lb. 5 oz. to 1 lb. 8 oz.
Water, to make 50 gallons.

To use instead of ammoniacal copper carbonate, on apple, grape, etc.

Warning:—In each case of change of grade or brand of commercial caustic soda it will be necessary to test the strength. Keep mixture well agitated. See Bulletin 130 for full directions as to testing. An easy mixture to operate with.

5. Potash Bordeaux Mixture.

For use like Soda Bordeaux mixture instead of ammoniacal copper carbonate.

Caution:—Prepare like Soda Bordeaux, only after test of the strength of the caustic potash.

6 Copper Sulfate Solution.

Copper sulfate, 4 pounds.
Water, to make 50 gallons.

Dissolve the sulfate as directed in Bordeaux I.

Caution:—This solution will injure foliage. It can be used only before the buds open.

7. Potassium Sulfid Solution.

Potassium sulfid (liver of sulfur), 1 ounce.
Water, 3 to 4 gallons.

This solution will not remain unchanged. The potassium sulfid must be kept in a well stoppered bottle.

8. Formalin

For oats and wheat smut, 1 lb. formalin to 50 gallons of water.
For potato scab, ½ pint formalin to 15 gallons of water.
For onion smut, 1 lb. formalin to 25 or 33⅓ gallons of water.

9. Corrosive Sublimate.

Corrosive Sublimate, 2 ounces.
Water, 15½ gallons.
Label, **Poison;** used for potato scab and for disinfection.

To hasten solution, have druggist pulverize the sublimate.

INSECTICIDES.

10. Kerosene Emulsion.

Dissolve one-half pound hard soap in one gallon of water (preferably soft water) and while still boiling hot, remove from the fire and add two gallons of kerosene. Stir the mixture violently by driving it through a force pump back into the vessel, until it becomes a creamy mass that will not separate. This requires usually from five to ten minutes. The emulsion is then ready to be diluted with water and applied. For the common scale insects and hard bodied insects, like the chinch bug, use 1 part emulsion to 8 or 10 parts water. For soft bodied insects (plant lice, etc.,) use 1 part emulsion to 15 or 20 parts water.

Kerosene emulsion kills by *contact*, and therefore the application should be very thorough. It may be used against a great many different pests, but is especially valuable for destroying those with sucking-mouth parts, for they cannot be killed with arsenical poisons.

11. Paris Green.

In combination with Bordeaux mixture, Paris Green may be used at the rate of 1 pound to 175 to 200 gallons.

When Bordeaux mixture is unnecessary, the Paris green may be used at the same rate, but 2 or 3 pounds of freshly slaked lime must be added to prevent burning of the foliage. Keep the mixture well stirred so that the poison will be distributed evenly.

In cases where successive sprayings are necessary it is important to consider the accumulation of poison and use a slightly weaker mixture, unless sufficient rain has fallen to wash off the poison thoroughly.

12. London Purple.

If desirable London purple may be substituted for Paris green, but it has the disadvantage of being somewhat variable in composition and contains more soluble acid. For that reason it must be used somewhat weaker, or else an abundance of lime provided, so as to prevent burning of foliage. It has the advantage of not settling as readily as Paris green.

13. White Hellebore.

Hellebore is often employed in cases where arsenical poisons would be objectionable. Use one ounce to three gallons of water.

14. Pyrethrum.

Pyrethrum is usually applied as a powder, with a bellows, but may be used as a spray at the rate of one ounce to two gallons of water.

15. Whale Oil Soap Solution.

Use from one to two pounds of soap to one gallon of water. Be sure that the soap is thoroughly dissolved, and then apply in form of spray. 1 pound to a gallon of water if used for peach leaf curl only.

16. Arsenites of Soda.

Dissolve two pounds of commercial white arsenic and four pounds of carbonate of soda (washing soda) in two gallons of water and use one and one-half pint to a barrel of Bordeaux mixture (50 gallons.)

The easiest way to make the solution is to put both the white arsenic and carbonate of soda in a gallon of boiling water and keep boiling about fifteen minutes, or until a clear liquid is formed, and then dilute to two gallons.

17. Crude Petroleum.

Crude Petroleum, undiluted and in different percentages, has been used on all kinds of fruit trees without injury, in various parts of the country. It may be safely used in any part of this State, provided the proper precautions are taken. Light oil, of about 45 degrees Baum, is less injurious, when used undiluted, than heavy oil. A clear sunshiny day should be chosen, preferably just before the buds open in the spring, and the trees should be sprayed lightly. Begin at the top of the tree and spray downward, and stop before the oil begins to run down the branches and trunk. If the work is done on a windy day, it will need to be repeated when the wind is in the opposite direction.

18. Lime, Salt and Sulfur Mixture.

Quicklime, 35 lbs.
Sulfur, 20 lbs.
Salt, 15 lbs.
Water, 50 gallons,

Boil 10 pounds of lime and 20 pounds of sulfur in 20 gallons of water for 2 hours. When the mixture turns an amber color add the remainder of the lime and 15 pounds of salt, and water to make 50 gallons. Use while hot.

19 Arsenate of Lead or Disparene

3 lbs. to 50 gallons of water.

Spray Calendar, for Apples and Grapes.

What to spray.	For What to Spray.	With what to spray.	WHEN TO SPRAY.				Remarks and cautions.
			First spraying.	Second spraying.	Third spraying	Fourth spraying.	
Apples	Bitter-rot.....	Soda Bordeaux or ammoniacal copper carbonate.....	With first appearance of rot or about 10 days after 3rd or 4th for scab.....	One to two weeks after 1st.....	Two weeks later.....	Not required if Bordeaux precedes.....	These follow Bordeaux for scab; danger on fair skinned apples.
	Scab.....	Bordeaux mixture I...	As buds are swelling.	Just before blossoms open.....	Just after the blossoms drop.....	Seven to ten days later	
	Sooty fungus...	Bordeaux I.....	After blossoms drop...	Two weeks later.....	These coincide with 3rd	and 4th for scab.....	White skinned apples are injured by spraying after third.
	Bud moth.....	Arsenites in Bordeaux I.....	With opening of buds..				
	Canker worm..	Arsenites alone, 11, 12, 16, or 19	With first young worms	In one week if worms remain.....	Same as second.....	.....	
	Codlin moth...	Arsenites in Bordeaux I or 19	As soon as blossoms fall	Seven to ten days later	These coincide with 3rd	and 4th for scab. Paris green. 16 or 19 alone on light apples.....	Arsenate of lead or disparene may be used.
	San José Scale.	Crude Petroleum. whale oil soap solution or lime, salt and sulfur mixture	After leaves drop in fall	Just before foliage starts in spring.....	.....	.....	Two lbs. soap dissolved in 1 gal. water. See 15.
	Wooly aphis. .	Kerosene emulsion.....	When trees are not in full leaf.....	In the fall.....	.....	.....	Don't use emulsion when trees are in full leaf.
Grapes	Anthracnose...	Bordeaux I.....	Just before buds open..	Just before blossoming	Just after fruit has set	Ten days later, Bordeaux I.....	Don't spray after fruit is half grown.
	Berry moth....	Arsenites with Bordeaux I.....	.....	After fruit has set.....	Ten to fourteen days later.....	.....	Don't spray with arsenites after July 1st.
	Downy & powdery mildew.	Bordeaux I.....	Just before blossoming	After fruit has set.....	Ten to fourteen days later.....	.....	Covered by spraying for anthracnose or rot.
	Rot.....	Bordeaux 1 and 3 or 4..	Just before blossoming Bordeaux I.....	Just after fruit has set Bordeaux I.....	Seven or eight days later, Bordeaux I....	Seven or eight days later, Bordeaux I....	Follow by three sprayings with soda Bordeaux or am. cop. carbonate.
	Leaf hopper....	Kerosene emulsion.....	Before young can fly...				

No. 238, May 5, 1902. SPRAY PUMPS AND SPRAYING APPLIANCES. (By W. J. Green.)

The Ohio Experiment Station has frequent inquiries concerning spray pumps and spray appliances. In replying to these inquiries it is the aim to supply addresses of manufacturers of successful patterns of spray pumps, &c., with such suggestions as will aid the prospective purchaser to select an outfit adapted to his own needs. (The Station does not care to advertise manufacturers.)

First.—Hand pumps adapted to placing on barrels or mounted tanks and capable of supplying a spray for two lines of hose and two nozzles. These are adapted to general orchard work.

Second.—Portable hand pumps for use on a bucket and adapted only to spraying a few trees, &c., and knapsack pumps. Both are portable.

Third.—Traction pumps with tank or barrel, mounted, the power to run the pump being supplied by traction. This class is quite well adapted to potato and vineyard spraying if supplied with two lines of hose for the latter purpose and the nozzles attached thereto are directed by hand.

Fourth.—Compressed air pumps. Small ones are portable like knapsack pumps and have a tight chamber into which air is pumped. Large pumps of this kind are scarcely on the market, though extremely desirable.

Fifth.—Power pumps, in which power is supplied by gasoline or steam engine. This class is expensive.

Sixth.—Dust sprayers for blowing powdered materials.

Only spray pumps of the first, third, fourth and fifth classes are adapted to extensive operations; the objection to the *first* class is the labor of pumping; to the *third* the inability to spray while not moving forward; to the *fifth* the cost and great weight of the outfit. The method of the *sixth* class is yet to be well tested. The advantages of the *first* class are comparatively low cost, the wide range of adaptability and the comparative ease of keeping in working order. For those just taking up orchard spraying some pump of this class is recommended.

The advantages of the *second* class are the still smaller cost and extreme portability. This applies to the small pumps of the *fourth* class and makes these all suited to the person with a small field or a few trees which require spraying, and where help is limited to a single person.

The *fourth* class, compressed air sprayers, will have many advantages when fully developed and put upon the market.

The *fifth* class is upon the market and will be carefully studied by a few who contemplate purchase of this type of sprayer.

The matter of dust sprayers for orchard applications of powders of like composition with Bordeaux mixture when dried, is in an undeveloped state as yet.

All pumps using Bordeaux mixture should have the working parts of brass to prevent corrosion.

MANUFACTURERS OF SPRAY PUMPS.

FIRST, SECOND AND THIRD CLASS.

Bean-Chamberlain & Co., Hudson, Mich.

The Caswell Spray Pump Co., Sandusky, O.

The Deming Co., Salem, O.

The Field Force Pump Co., Lockport, N. Y.

Gould's Mfg. Co., Seneca Falls, N. Y.

Hardie Spray Pump Mfg. Co., Detroit, Mich.

Humphreys & Co., Mansfield, O.

Barnes & Co., Mansfield, O.

Latham & Co., Sandusky, O.

Morrill & Morley, Benton Harbor, Mich.

F. E. Myers & Bro., Ashland, O.

Mr. Throop, mechanic, Geneva, O. (Traction only.)

POWDER DUSTERS OR GUNS.

Leggett Bros., New York, N. Y.

Excelsior Co., New Haven, Conn.

Dust Sprayer Mfg. Co., Kansas City, Mo.

COMPRESSED AIR SPRAYERS.

The Ripley Hardware Co., Grafton, Ill.

Rochester Spray Pump Co., Rochester, N. Y.

POWER PUMP SPRAYERS.

The Advance Mfg. Co., Hamilton, O.

Gould's Mfg. Co., Seneca Falls, N. Y.

PUMPS FOR MIXTURES OF OIL AND WATER.

Spramotor Co., London, Ont.

Deming & Co., Salem, O.

SPRAY APPLIANCES.

These are obtainable of nearly all manufacturers and dealers.

Hose.—Good 3-ply ½ inch rubber hose, in lengths of 25 feet is needed for carrying the nozzles. Short hose restricts action and is unprofitable.

Nozzles.—The Vermorel pattern is one of the best—the double Vermorel (Morrill & Morley) is especially to be recommended for vineyard and extensive orchard spraying. The Bordeaux nozzle (Deming & Co.) has some goods points, as has the Caswell (Caswell) and others. The double Vermorel is recommended without reserve.

Shut-offs.—These should be inserted at point of holding to prevent waste.

Extension rods of bamboo, gas pipe or brass pipe, carrying shut-off at base and nozzle at end are necessary for orchard and general work. These may be obtained in various lengths, but should not be excessively long.

PRICES OF SPRAY PUMPS.

This matter is one of competition among manufacturers to a considerable extent, amd prices are not high at the present time. A fair to good quality hand pump of the first class may be obtained at from $6.00 to $15.00 with appliances, barrel, tank, etc., extra.

The matter of purchasing pumps and appliances should be taken up with local dealers or the manufacturers.

For information concerning spray mixtures, spray calendars and directions, address, Ohio Experiment Station, Wooster, O.

No. 239, May 12, 1902. FIGHTING THE CHINCH BUG. (By Chas. E. Thorne.)

Letters received at the Ohio Experiment Station state that the chinch bug is again making its appearance in various parts of the State, being observed in the young wheat.

It has been observed that in damp weather chinch bugs often become infected with a fungous disease, resembling a white mould, which soon causes them to die. The Experiment Station has cultivated this fungus, and is sending out small packages of the culture to those who apply for it, in the hope that it may cause the bugs to become infected with the disease at an earlier date than would otherwise happen.

To use this remedy, the material sent (which resembles dried yeast) should be finely pulverized and distributed, a very little in a place, where the bugs are found in largest numbers, preferably on low or damp ground. The bugs which become infected will communicate the infection to others.

Only one small package of this culture can be sent to each applicant, but its work may be extended by collecting bugs found to be infected and distributing them among others. This will at least reduce the danger of attack next year.

This remedy requires damp weather for successful operation, and farmers should not depend upon it alone. As the wheat matures the bugs will leave this crop in search of fresher pastures, and will probably attack neighboring fields of oats or corn. The chinch bug is especially fond of millet and similar grasses, and a farmer who finds his wheat fields infested will do well to sow a narrow strip of millet between the wheat and his other crops.

As the proper time for sowing millet is during, or just after, the corn planting season, a strip of millet two or three yards in width may be sown along the side of the corn field next to the infested wheat or oats, and when the bugs have taken possession of it the millet may be plowed under with a pointer plow and the ground harrowed and rolled, thus burying the bugs.

The progress of the bugs from field to field may also be obstructed by making a V-shaped trench with the corner of a hoe and filling it with coal tar, the tar to be renewed as soon as it becomes crusted over. Another method which has been suggested is to plow a deep furrow across their track; the bugs which get into this furrow will have difficulty in getting out again, and they may then be killed by sprinkling them with kerosene emulsion made as follows:

Dissolve half a pound of soap in one gallon of water and heat to boiling; remove from the fire and while hot add two gallons of coal oil, churning the mixture with a force pump for fifteen minutes or until it resembles buttermilk. To each quart of this emulsion add fifteen quarts of water and apply with a spray pump or sprinkling pot.

This emulsion may also be used where the bugs have attacked the outer rows of corn, using a spray pump and throwing it with sufficient force to wash them off the corn.

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